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ENGINEERING AND MINING JOURNAL

SEPTEMBER, 1940

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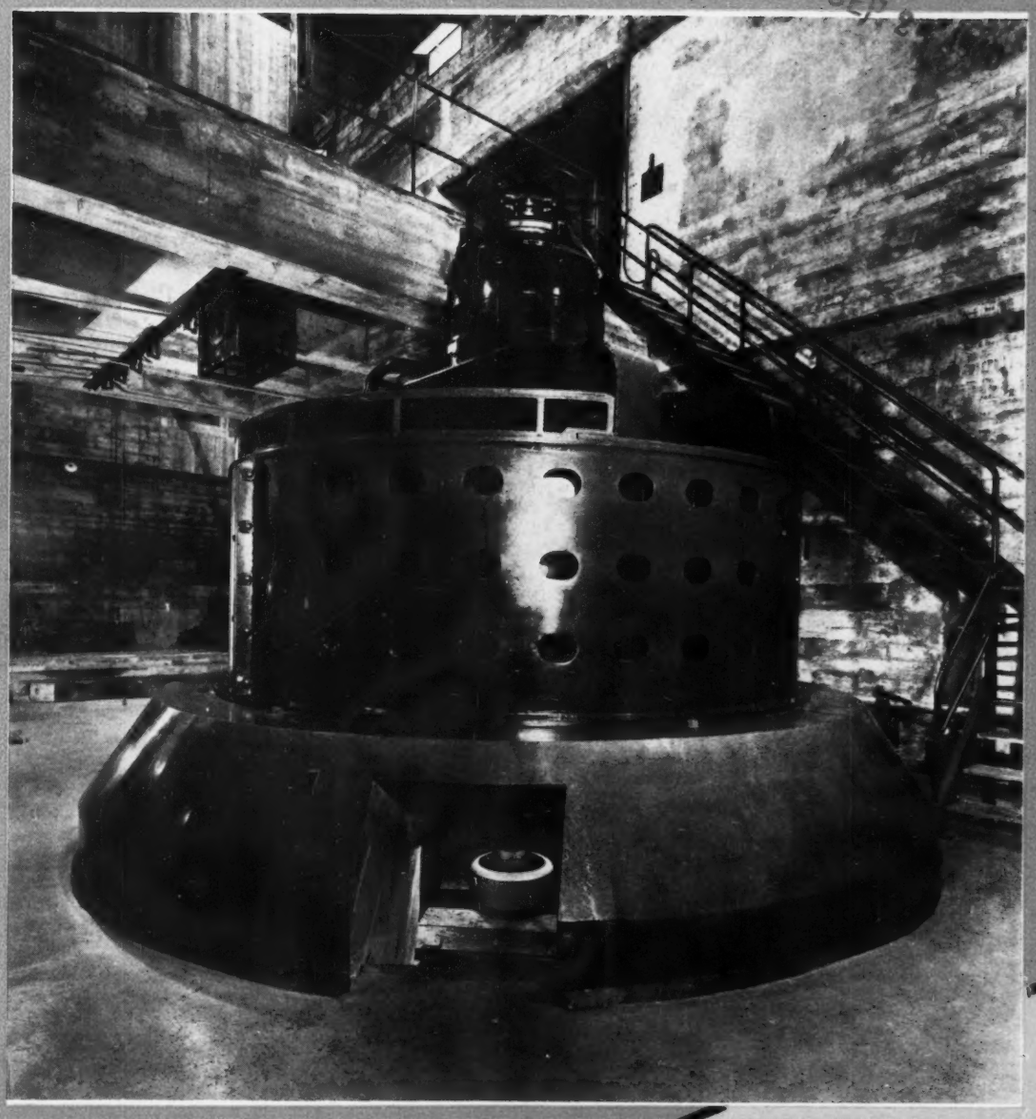
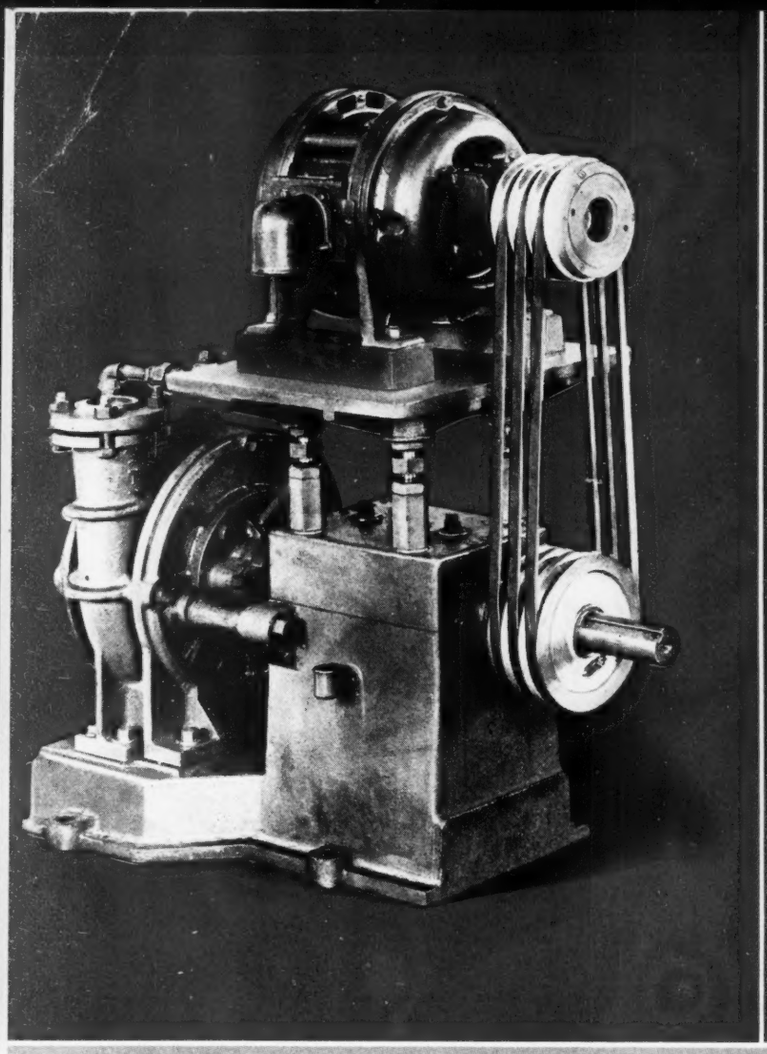
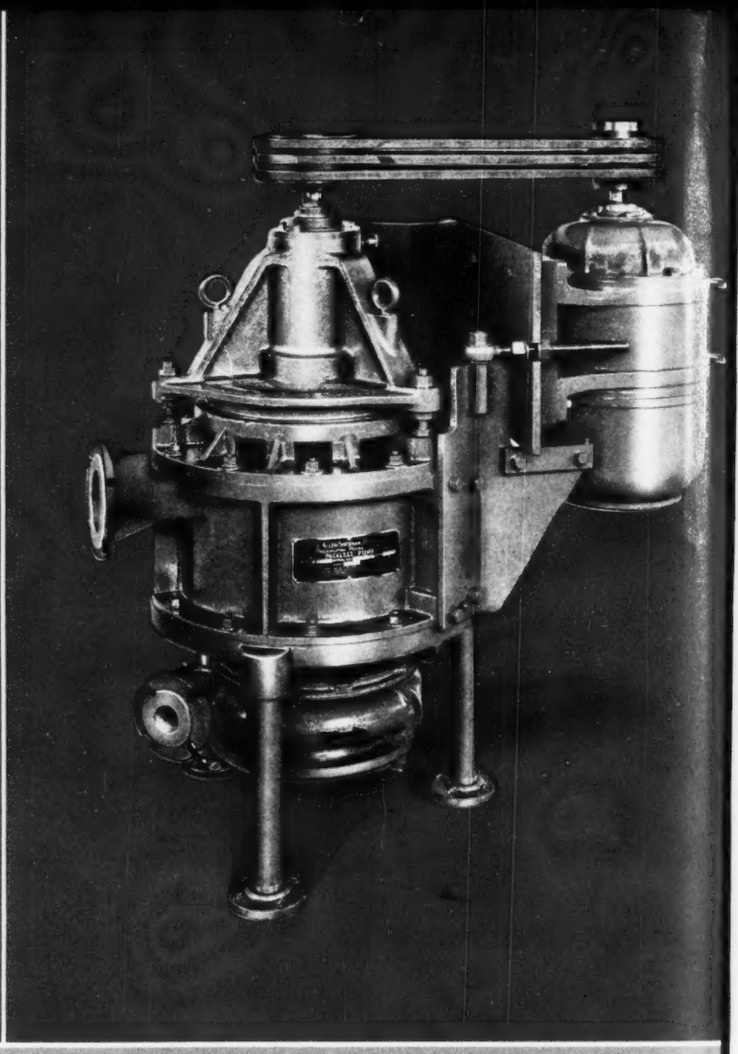


Turbine of hydro-electric power plant of Pend Oreille Mines & Metals Company, on Pend Oreille River, Washington, below Metaline Falls.

In this issue

The Ferrosilicon Sink-and-Float Process
Phosphate—the Vital Non-Metallic
Strategic Minerals in Latin America
New Cornelia Today • World Zinc Reserves
Cost of Dredging on Klamath River
Complete Contents on Page 27





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Tomorrow's mining methods furnished an interesting topic which was ably treated by Mark A. Smith in *E.&M.J.* of March, 1940. As he then visualized the methods of the near-by future, mechanization of a high degree is to be expected, using all applicable equipment, data, and technical skill that are available. In the October issue he will follow up this earlier discussion with a second article dealing with the use of slushing, or scraping, in cave mining at a Western property. "With this background," he states, "slushing is seen to be in an evolutionary state, which implies continued expansion."

▼

Shareholders of International Nickel in the United States are reminded in a company circular that they are investors in a Canadian industry and that the dividend check sent this month is derived from Canadian-produced material. Canada has a struggle on her hands, the circular continues, is buying U.S. products, and needs U.S. dollars, the same as those in which the dividend is paid. Canada's attractions are suggested for a holiday at any season. Visitors from the United States are not restricted, passports are not required, and a fixed premium of 10 per cent is paid on U.S. funds. Ho, for Lake Louise!

▼

On visiting Canada from the Rand, a certain mining engineer failed to find anything that looked like home, he recently averred, until he reached the Hollinger. Had he visited around the United States, he would have found the Homestake also. Gold mining on the Rand is truly on a magnificent scale. Official statistics for 1939 showed 316,760 blacks employed.

▼

The suggestion box has come to Washington or will be there shortly. Into it anyone may drop his bright idea for aiding the national defense. Differently expressed, a National Inventors Council is to be set up with Charles Kettering, of General Motors, as chairman.

H. C. PARMELEE
Editorial Director

ENGINEERING AND MINING JOURNAL

H. W. CLARKE
Vice-President

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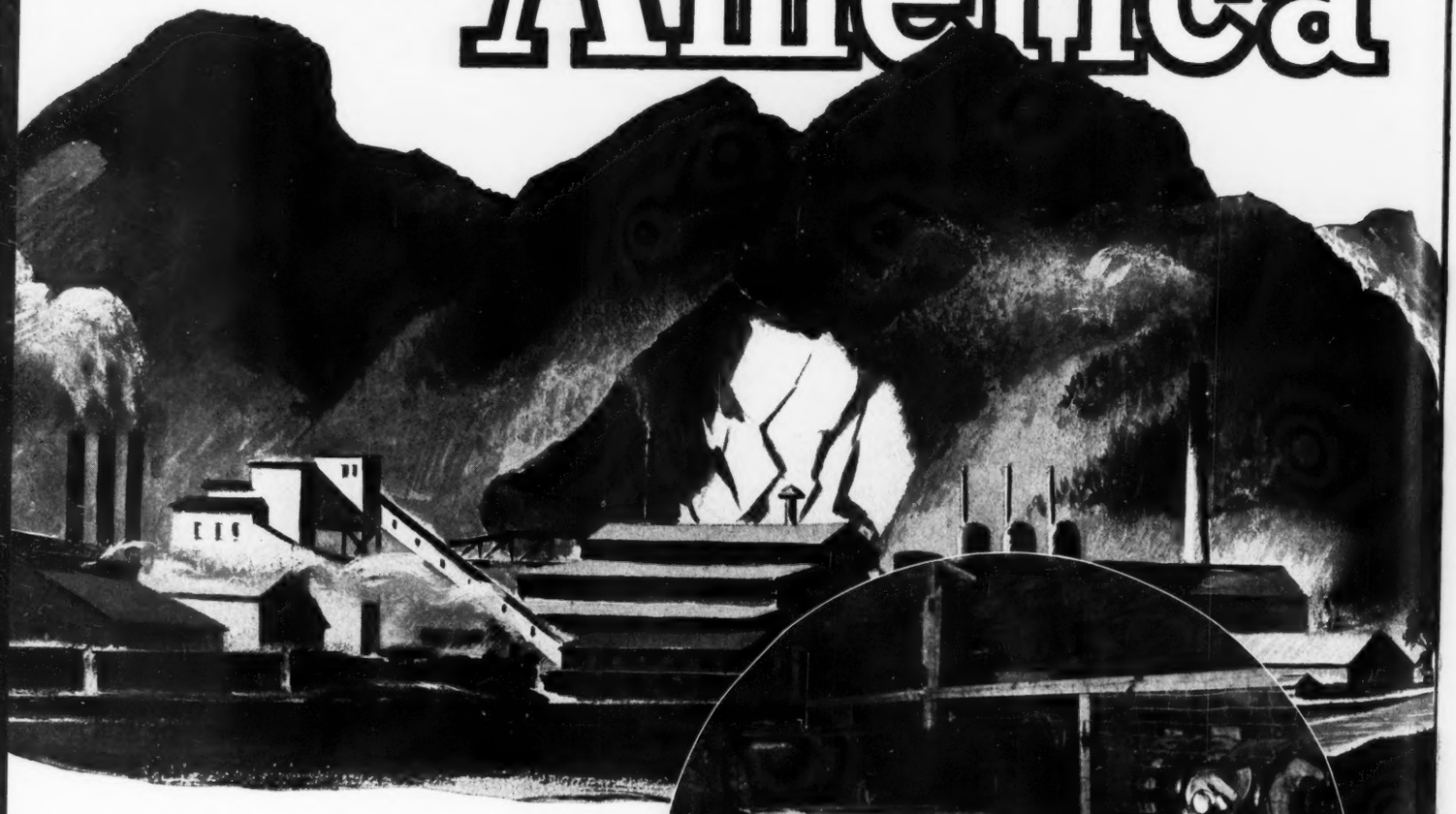

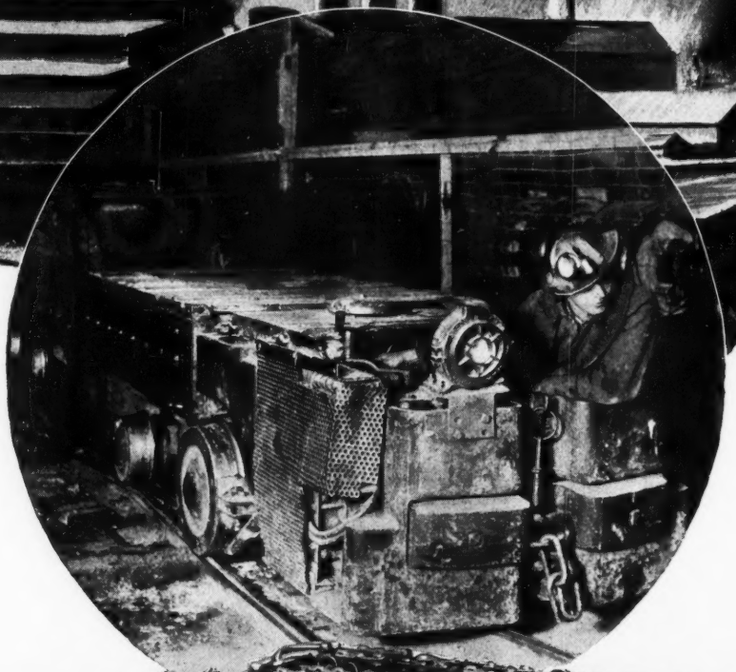

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Volume 141 SEPTEMBER 1940 Number 9

Pass the Word Along

IT IS VITALLY IMPORTANT that the man in the street should understand two things about the program for national defense. First, that time — a great deal of time — will be required to carry out the plans for industrial production. Second, that the principal current delay in getting production under way is chargeable primarily to the Government itself, and not to industry. Without a clear understanding of these things, the public may become critical, even resentful, at seeming lack of progress. And an Administration none too friendly to industry is not likely to shield it from public criticism —not in a year of national election with a third term hanging in the balance. Quite the contrary. The tendency will be to absolve the Government and make a scapegoat of industry.

So it is up to representatives of industry to spread a doctrine of common sense among the rank and file of the public. Admit that Congress has appropriated billions, in fact much more than can be spent this year and next. That's easy compared with the production of all the tanks, planes, battleships, and other items of defense for which the money was provided. In many cases even the factory facilities and skilled labor are lacking. Army and Navy officers understand the situation. So does the Advisory Commission for National Defense. They expect the inevitable lag between orders and production, between blueprints and construction. They know the difference between 50,000 airplanes as a topic of conversation, and a fraction of that number as a concrete reality. But the public may not understand unless the point is made clear by those who know what it means to build, equip, and operate industrial plants. The execution of our whole program is a matter not of months but of years, and the man in the street should understand it.

The second point is even more critical. Straws in the wind already point to political criticism of industry for its failure to accept contracts and start production. But what are the facts? The failure of Congress to reach a decision on excess-profits legislation, and provision for amortization of capital invested in war plants, is at the bottom of the delay. No manufacturer is going to accept a contract to produce war supplies, or build a new plant solely for that purpose, without knowing what his taxes are to be, or who is to own the plant after the emergency, or how rapidly he may amortize such an extraordinary investment of capital. Until these matters are settled, inaction will mark a large part of the defense program. In the meantime the political cry will be raised that industry is more concerned with profits than with national defense, and the inference will be allowed to prevail that industry has failed in its patriotic duty. Let nobody be deceived. The Administration is responsible for the current delay in expediting that part of the defense program that depends on industrial production.

Aliens Must Register

ON AUGUST 27 the Department of Justice inaugurated the largest finger-printing program ever undertaken in this country. It was a part of a nation-wide registration under an act of Congress that requires all aliens fourteen years of age or older to register at a United States post office before December 26, 1940. Alien children under fourteen years of age must be registered by their parents or guardians. It is estimated that more than three and one-half million aliens will be registered and fingerprinted during the four-month period.

This action has been taken by the Government as a measure of national defense. It is designed to protect not only the country, but also those loyal aliens who comprise a part of our population. It carries no implication of hostility towards them; but it will serve as an aid in apprehending those undesirable aliens who are here for no good purpose and who should be under surveillance. Mining companies are urged to cooperate in this program by assisting their aliens employees to comply with the law, and thus escape the rather harsh penalties for failure to register.

Tin Twaddle and Other Nonsense

ONE finds it reasonably easy to be patient with the inevitable delays and difficulties in acquiring strategic minerals and metals for national defense. But it's hard to stay good natured and tolerant with the nonsense of incompetent busybodies who dabble in the subject, particularly when they peddle their misinformation to the public. Consider, for example, the alleged startling disclosures about tin by two Washington columnists, Pearson and Allen, in their syndicated "Merry-Go-Round." It would be difficult to find anywhere more fancy and less fact than is packed into their column for August 1, 1940.

There, for instance, they reveal "one of the most inexcusable chapters of national defense neglect in history;" and by the State Department, of all people. They tell us, also, that "almost nobody knew that on Jan. 1 the U. S. stocks of tin were so low that we had only three weeks' supply." If they had consulted the Bureau of Mines they would have learned that the tin-plate industry alone had on hand 4.7 months' supply at the 1939 rate of consumption. Then, by devious wording they link Patiño of Bolivia, the British tin monopoly, and the National Lead Company in a conspiracy to deprive the United States of a tin-smelting industry, despite national defense interests, and with the State Department conniving in the nefarious plot. Could anything be more fantastic? "Upon what meat doth this our Caesar feed, that he is grown so great?"

What Pearson and Allen could have discovered if they had cared to take the pains is that the United States has no tin-smelting industry principally because it controls no substantial deposits of tin ore. Political and commercial control of tin happens to reside in Britain, the Netherlands, Thailand, Bolivia, and other countries. They prefer to smelt their ore where it is most profitable and sell the metal to the United States. And why not? It's their tin. But times and conditions change, and it is quite possible that a tin-smelting industry may be established here if we can be assured of an adequate and continuing supply of ore and concentrate. But if and when tin smelting is established in the United States it will be because we want it and are willing to pay for it, and not because some imaginary conspiracy against it has finally been broken.

In their column for July 24 Pearson and Allen purvey considerable misinformation about magnesium. They attribute control of the domestic supply of that metal to the Aluminum Company of America, a statement so obviously ridiculous that it could have been made only in ignorance or malice. They confuse names of people, and drag in a sly reference to the I. G. Farbenindustrie, of Germany, as one of the conspirators with the Aluminum Company in maintaining a monopoly on magnesium. The whole statement is an uncorrelated jumble of inaccuracies.

The pity of all this is that the public is fed with that kind of stuff by irresponsible writers who are really specialists in political gossip. Their technique is to discover mares' nests—to "reveal" something that "almost nobody" knows. They should stick to their specialty, because they get beyond their depth when they venture into the field of industry where facts and figures prevail and gossip is at a discount. Such activity is bad enough at any time, but inexcusable in a period when the public ought to be enlightened with facts.

Latin America's Storehouse

OF THE important considerations in any plan for national defense, whether this be narrowly conceived for only the possessions of the United States or more broadly for all the Western Hemisphere, two are related to each other. These are the maintenance of good relations with our neighbors in Latin America and, second, the provision of adequate supplies of the various commodities classed as strategic or essential. The link between the two is the simple fact that the more we can buy from our neighbors to the South, the more readily they will turn to us and the stronger their economy will be. Moreover, if the commodities bought are among those in which we are deficient, it will mean that we will be establishing important supply lines that we can be reasonably sure of maintaining. This applies even to Mexico, although, to be sure, that country's present administration has been conducting itself toward our investments within its borders in a manner that tends to strain relations, to put it mildly.

Latin America already can supply various commodities in which we are deficient and, in many places, could doubtless tap additional resources, perhaps with financial encouragement, judiciously provided. Elsewhere in this issue, its possibilities are dealt with interestingly by Sydney H. Ball and next month P. H. Reagan, writing from LaPaz, will deal with the opportunities in Bolivia, where tin, tungsten, and antimony are important products. These contributions, it is hoped, may aid in promoting more rapid action in this serious matter.

An exterior view of Butler Brothers' Harrison No. 3 concentrator at Cooley, Minn., on the Mesabi range

Sink-and-Float Separation Applied Successfully on the Mesabi

Ferrosilicon provides an easily cleaned, efficient medium. Using this new high-density process, 400,000 tons of iron ore had been treated up to July 1 last in Butler Brothers' plant

Grover J. Holt
Mining Engineer, Butler Brothers
137 East 8th St., St. Paul, Minn.

UNTIL 1924 the washing of iron ores in Minnesota depended largely on methods of classification rather than concentration. The only problem lay in the removal of minus 100- or 200-mesh sand from the coarser iron particles. In that year, the Stanley Mining Company, of which Emmett Butler was president, installed the first iron ore jigs in the State. This property produced ore continuously until 1929, when the plant was dismantled and the jigs were installed in the Harrison washing plant of Butler Brothers at Cooley, Minn. These jig units together with additional units have been producing concentrates successfully since then.

The grade of the ore in the properties has continued to fall and the ores have become more difficult to treat, even in jigs. By 1936 it was evident that adoption of some more refined method of concentration was inevitable.

In 1931, the Chance process of sand flotation for coal had been investigated, but the technicians of the Chance Company were never able to develop their process to fit iron-ore requirements. It was not until the fall of 1936 that Victor Rakowsky, of Joplin, Mo., presented worth-while evidence that a commercial high-density unit involving solid mediums was entirely practical.

In the winter of 1936-1937, a test unit was set up at the Mines Experiment Station of the University of Minnesota and iron ores and manganiferous iron ores were successfully treated in a 3-ft. diameter test cone. During the summer of 1937, a commercial-sized unit was built at the Merritt plant at Ironton, Minn. Although metallurgical results were satisfactory, it was found that the galena was difficult to clean properly for returning to the circuit and that it ground up so rapidly in the course of the process that the loss in overflows exceeded the limits of commercial application.

The idea of using a magnetic metallic medium was conceived during the period mentioned and definite tests as to suspension qualities were made on crushed steel and ferrosilicon in the early fall of 1937 by the staff of Butler Brothers in conjunction with Henry Wade, of the Mines Experiment Station. During the ensuing test work,

---

The ferrosilicon sink-and-float process now being used by Butler Brothers of St. Paul, Minn., in their new plant at Cooley, Minn., was employed for treating 300,000 tons of iron ore in 1939 and 400,000 tons up to July 1, 1940. The American Zinc, Lead & Smelting Company, 943 Paul Brown Building, St. Louis, Mo., exclusively controls the licensing of this process in the United States, Mexico, and Canada for all types of ore.

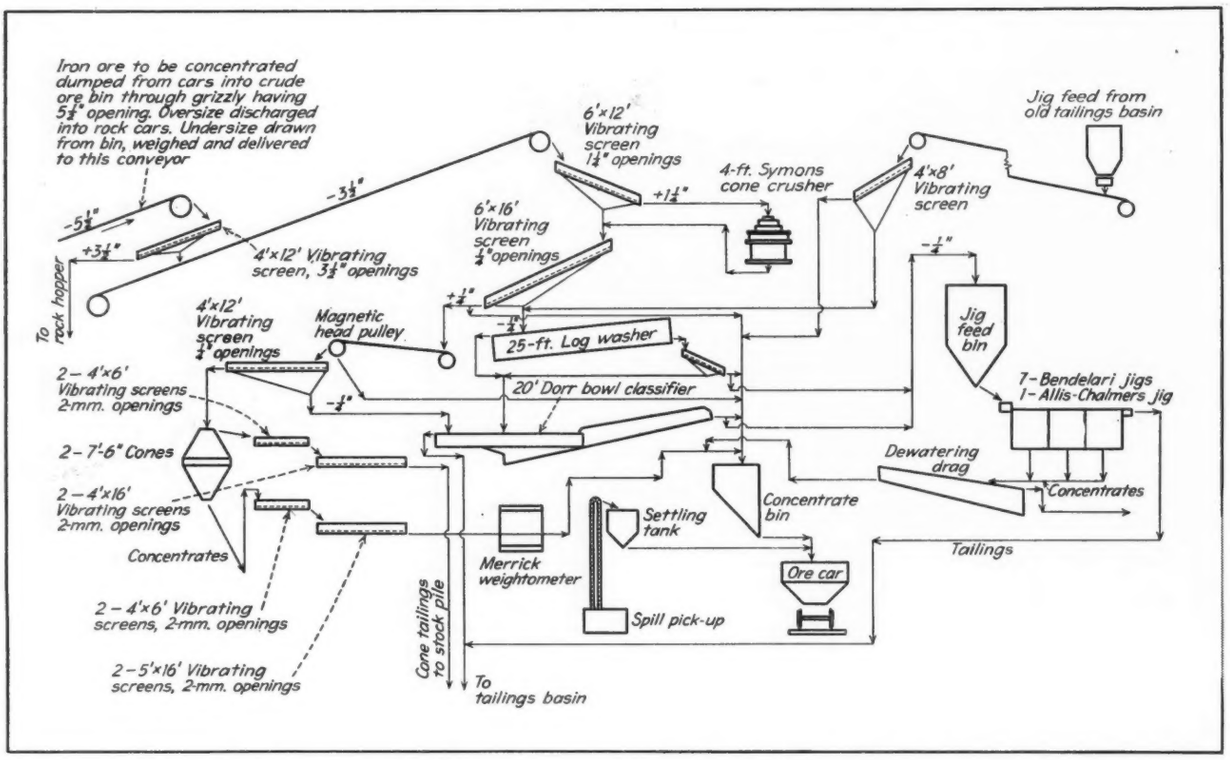


Fig. 1 . . . Flowsheet of Butler Brothers' Harrison concentrator No. 3, at Cooley, Minn., in 1939. This illustrates the relation of the two 7½-ft. cones installed in the plant that year to the rest of the ore-treatment procedure

various shapes of cones were used in small laboratory models and the inverted-top type was found to be the best. A 3-ft.-diameter cone of this type in a magnetic recovery flowsheet was used at the Experiment Station. This was followed by the installation of a 4-ft.-diameter cone unit with a complete magnetic-recovery flowsheet at the Patrick plant in the summer of 1938. This 4-ft. cone treated tonnages up to 40 long tons per hour of feed and operated during all of the shipping season of 1938. As a result of this pilot unit, two cones, 7½ ft. in diameter and capable of treating upwards of 350 long tons per hour were installed in the Harrison plant in 1939 and operated steadily during the shipping season, except for time spent in remodeling the units for the removal of weak points. These units replaced a battery of 60 coarse jig cells.

Heavy-density Separation vs. Jigging—During the 1939 season, no comparative results were obtained in direct competition between the two methods, inasmuch as the heavy-density plant was operated as a production unit solely. In 1938, however, the pilot unit obtained exactly the same feed as that treated in the jig plant, with the results that are presented in Table I.

The ores treated in these tests over a three-months period varied widely, but in every case the feed to the two units came from the same feed conveyor belt.

Sink-and-float tests conducted on the cone concentrates that were produced showed less than 0.5 per cent of float material, all middlings of fine size. The cone tails showed the presence of less than 2 per cent of sink material, which was also a middling product.

Table I—Comparison of Results—Heavy-Density Separation vs. Jigging

	Cone Unit					Jig Unit				
	% Weight	Concentrates		Tailings		% Weight	Jig Concentrates		Jig Tails	
Sp. Gr.	Recovery	% Fe	% SiO_2	% Fe	% SiO_2	Recovery	% Fe	% SiO_2	% Fe	% SiO_2
2.90.....	88.91	55.75	11.89	21.91	60.23	71.05	55.46	12.01	41.57	31.20
3.00.....	85.10	57.42	9.56	31.98	44.08	79.90	56.04	11.54	40.75	34.08
3.05.....	80.20	58.26	9.05	36.97	37.91	66.88	57.76	9.91	46.48	24.53

Comparison of Above Results

		High-Density Concentrates		High-Density Tails	
Average Sp. Gr.	% Increased Recovery High Density	Increased % Fe Over Jigs	Decreased % SiO_2 Under Jigs	Decreased % Fe Under Jigs	Increased % SiO_2 Over Jigs
2.90.....	17.81	0.29	1.20	19.66	29.03
3.00.....	5.20	1.38	1.98	8.77	10.00
3.05.....	13.30	0.50	0.86	9.51	13.38
Weighted average.....	13.40	0.62	0.83	12.80	18.22

Sink-and-float tests on jig concentrates showed from 6 to 9 per cent of float material and jig tailings from 45 to 50 per cent of sink material at the gravities at which the cone was operating.

Description of Medium—Several crushed ferro-alloys were tested, but ferrosilicon containing about 83 per cent iron, 14 to 15 per cent silicon, and 1 to 2 per cent of carbon and non-magnetics was selected because of its high specific gravity, resistance to oxidation, and desirable magnetic qualities of susceptibility and permeability. Also, 15 per cent ferrosilicon was the most economical from considerations of first cost of any of the metals and alloys used combining the characteristics noted. For specific purposes, however, others of the alloys may be used.

Fifteen per cent ferrosilicon has a specific gravity of 6.7 to 7.0, is extremely hard, being from 5 to 6 in Moh's scale, and can be crushed only by heavy impact in ball or rod mills, usually dry and air-swept. Ferrosilicon made both in electric furnaces and in blast furnaces has been used, with no apparent difference in results. If the silicon content increases above 15 per cent, the magnetic qualities decrease and if it falls below 15 per cent, the resistance to oxidation is thereby lowered.

Particle size of the ferrosilicon used is preferably minus-65 mesh with approximately 96 per cent minus-100

mesh and about 65 minus-200 mesh. In practice, the material is mixed with water to give the desired specific gravity for the purposes of separation and the specific gravity is changed at will, by regulation of the water content of the pulp.

Specific gravities of from 2.5 to 3.4 are attainable. In practice, a rule has been well established that in a solid-water medium, the maximum workable specific gravity that can be attained is about one-half the specific gravity of the solid particles used to make up the medium. From this it is evident that the medium must be kept clean by removal of light quartz and clay particles in order to work at high specific gravities. This cleaning is easily done by means of magnetic separators.

Table II shows the specific gravities of ferrosilicon medium containing varying percentages of solids by weight. Due to the fact that the solids are hard to keep in suspension below 70 per cent solids by weight, operation at specific gravities less than 2.5 is not recommended. A high limit of specific gravity with 15 per cent ferrosilicon would be from 3.40 to 3.50, inasmuch as above this point, viscosity would increase beyond the point of operating possibility even with a clean medium. Some alloy of higher specific gravity should be selected for specific gravities higher than 3.4, such as crushed steel treated to prevent oxidation. Reagents to reduce the viscosity of pulps are being considered to attain higher working gravities.

Recovery of Medium Solids—Non-magnetic mediums must be cleaned by gravity methods or by flotation and this becomes difficult in the fine particle sizes used. A magnetic medium may be thickened prior to cleaning much more easily than the non-magnetic mediums. This is accomplished by passing the wash water carrying the medium and ore particles through a direct-current magnetizing coil or by the employment of Alnico permanent magnets.

In passing through this coil or between the permanent magnet blocks, the magnetic medium particles become magnets on a small scale and the finer particles adhere to the larger particles, thus making the settling action much more rapid.

The magnetic separators or cleaners are set for the proper field strength and the cleaning becomes automatic without reliance on the human element required in gravity or flotation cleaning methods. Cleaning continues up to maximum efficiency so long as power is uninterrupted.

The medium remains magnetized throughout the cleaning circuit and is only demagnetized by flowing through an alternating-current coil at some point just before it is returned to the main circuit.

This method of cleaning can be controlled with selected medium solids to the point where even natural magnetite may be rejected and the medium solids recovered.

Efficiency of the Process—A true

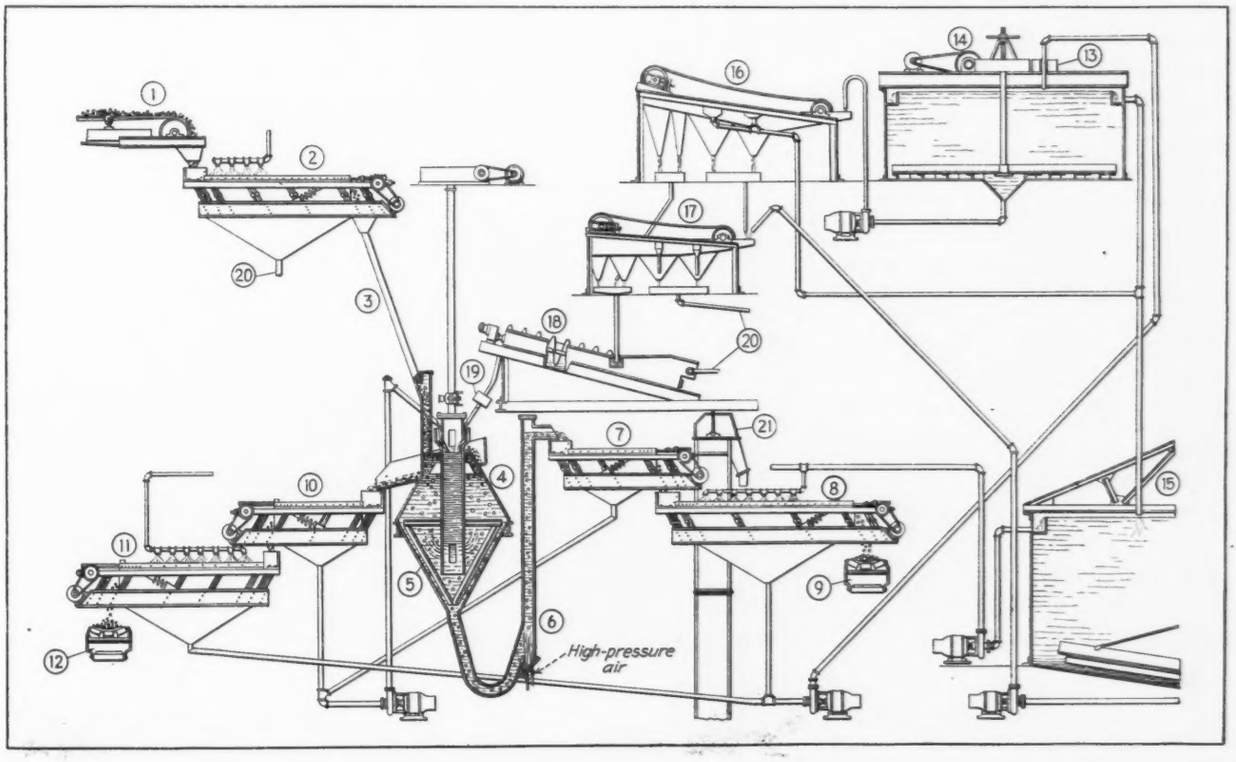
Table II—Specific Gravities of Ferrosilicon Medium Based on That Used in Operation

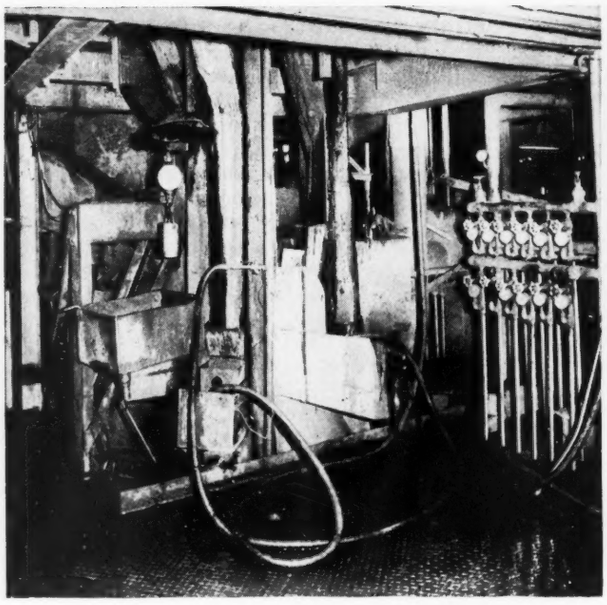
Specific Gravity	% Solids	Lb. Solids Cu.Ft.
1	0	0
1.03	5	3
1.07	10	7
1.12	15	11
1.17	20	15
1.23	25	20
1.30	30	26
1.39	35	32
1.50	40	38
1.62	45	45
1.74	50	54
1.89	55	64
2.05	60	74
2.24	65	87
2.48	70	105
2.78	75	127
3.17	80	155
3.62	85	195
4.23	90	250
5.20	95	325
6.70	100	418

Fig. 2 . . . Flowsheet illustrating the procedure in the sink-and-float separation, including the medium-cleaning circuit

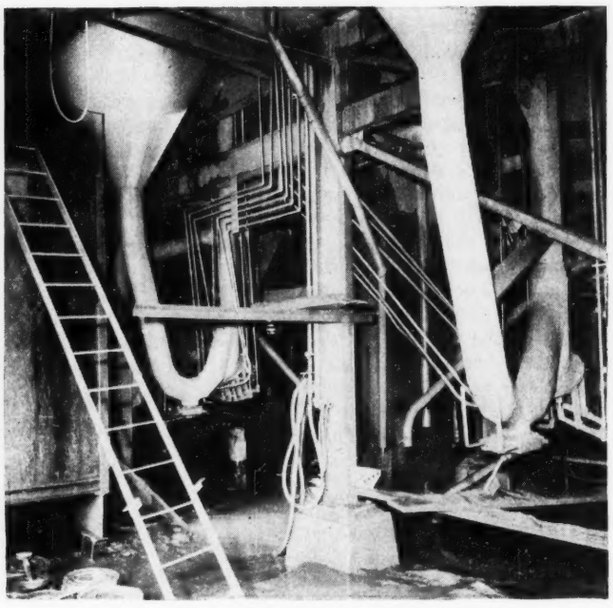
LEGEND

1. Crushed ore, roughed, washed, screened
2. Washing screen
3. Sized washed feed
4. Cone separator
5. Agitator
6. Concentrate air lift
7. Concentrate drainage screen
8. Concentrate wash screen
9. Cone concentrates
10. Tailing drainage screen
11. Tailing wash screen
12. Cone tailings
13. Magnetizer
14. Thickener
15. Clarification tank
16. Roughing magnetic separator
17. Finishing magnetic separator
18. Reclaimed medium supply
19. Demagnetizer
20. To jig plant
21. Clean-up and new medium elevator





At the top of one of the 7½-ft. diameter separating cones. This is known as the operating floor



Bottoms of the two cones and the respective airlifts, as seen in the basement of the plant

specific gravity separation has been the aim of development in all forms of jigs, tables, and other gravity concentration equipment. This process does not depend on the laws of either free or hindered settling ratios of mineral and gangue. Other methods depending on these laws are found to be affected by size and shape of particles, as well as ratios of concentration which require that some adjustment be made even in ores which are similar in structure.

Structure of the ore, which can be improved only by finer crushing, is the sole factor which need be compensated for in a true sink-and-float separation.

Variations in the rate of feeding a sink-and-float unit have no effect on the separation made, provided such feed rate does not exceed the rated capacity of the unit. In a plant designed for 150 tons per hour a feed rate of one ton per hour results in as perfect a separation as is attained at maximum rated capacity.

Many refinements in connection with high-density sink-and-float operation have been worked out on a commercial scale. These include:

1. Pumps for circulating medium to replace bucket elevators which are costly to maintain.

2. Screw-type classifiers for the thickening of cleaned medium before returning it to the circuit.

3. Installation of Masseo density indicators to measure and control the specific gravity of the medium continuously and accurately. This eliminates the necessity of weighing known volumes of medium.

4. Subsurface feeding of the ore into the medium and elimination of excess moisture in the washed feed. In subsurface feeding the water is squeezed from the particle surface and rises in the feed chute and can be eliminated by means of drain pipes.

5. Drainage and washing screen decks have been perfected to eliminate high maintenance costs.

6. The entire process and equipment have been developed along practical principles to eliminate the human element and guesswork so far as this is possible.

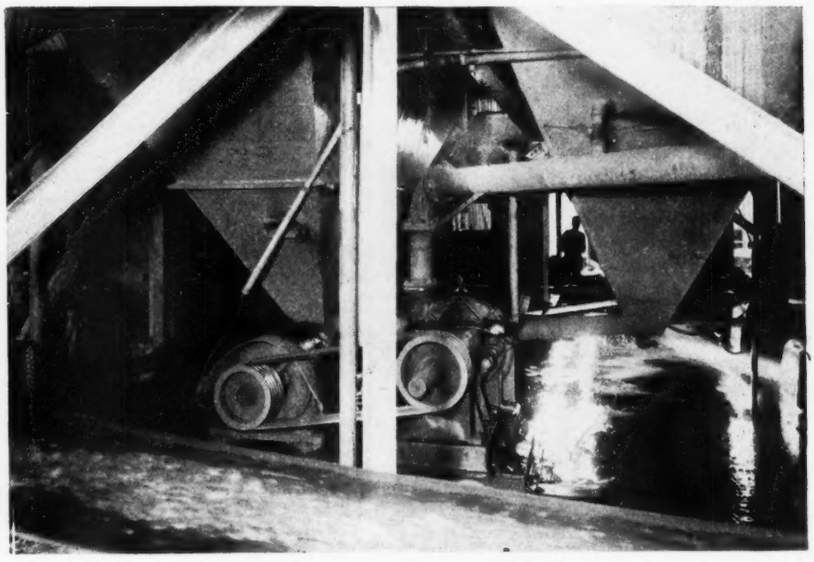
Flowsheet of Preliminary Preparation Plant—The preparation plant consists of grizzlies, screens, a cone crusher, log washer, and bowl classifer. See Fig. 1.

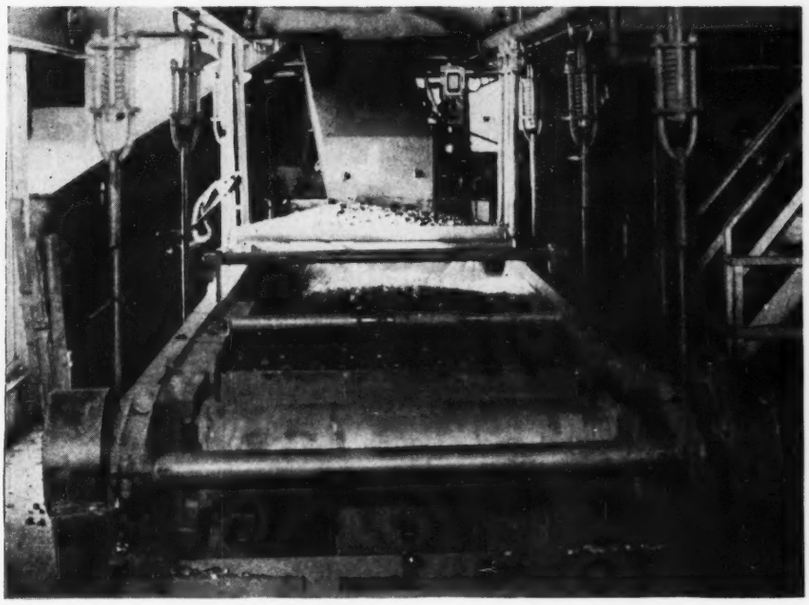
The present high-density plant treats iron ore sized between 1¼ in. and ¼ in. The minus ¼-in. ore collected in the log washer and bowl classifier is treated in a modern jig plant consisting of seven Bendelari diaphragm jigs and one Wade or Conset air-pulsated jig.

The high-density plant consists of two units, each of which has a separating cone and the necessary screens, medium-circulating pumps, and the medium-reclamation and cleaning circuits.

Primary Washing Screen—The ore enters the high-density plant over a 30-in. belt conveyor capable of handling the feed rate of 400 long tons per hour. The head pulley of this conveyor is equipped with a magnetic head pulley for removing tramp iron.

Another basement view. These are the wash-water sumps and the pump





Primary washing screen which receives the feed as it enters the high density plant. It is a 5x14-ft. Robins Eliptex unit having a ¼-in. screen deck. Washing is done by sprays

A 5x14-ft. Robins Eliptex screen, having a ¼-in. screen deck, receives the feed, which is washed by means of sprays for the final removal of slime and sands. These sands join the fines delivered to the bowl classifier and the oversize is ready for cone treatment.

Separating Cones—The ore is discharged from the screen into six rectangular chutes, three of which feed each cone subsurface and are used for water drainage, as described previously. The cones are constructed by using an inverted truncated cone for the top half and a truncated cone for the lower half, as shown in Fig. 2. The separating zone in the cone is a comparatively narrow horizontal band near its top. Separation of products is almost instantaneous, with tailings rising to the lip of the upper inverted cone and flowing over the lip of the cone, with excess medium and concentrates sinking to the air lift at the bottom of the lower cone.

Medium enters the cone through the central pipe, which is 6 in. in diameter, and, by means of a drive mounted above the cone, this pipe acts also as a drive for the blades which rake concentrates down the 60-deg. cone bottom to the air lift. Medium enters this pipe above the top of the cone by means of a funnel construction and slots in the pipe and is discharged through slots near the bottom as well as the open bottom of the pipe. The medium from the slots travels upwardly to discharge with the tailings and from the open pipe bottom travels downwardly to enter the concentrate air lift. The rising medium keeps the cone clear of accumulations of the middlings.

Drainage Screens—Tailings overflowing with the excess medium flow onto 4x6-ft. Nordberg flat-deck vibrating screens decked with 2-mm. punched plates.

Concentrates discharged with the excess medium flow onto 4x6-ft. Nordberg screens, which are duplicates of those used on tailings. These decks also are 2-mm. punched-plate screens.

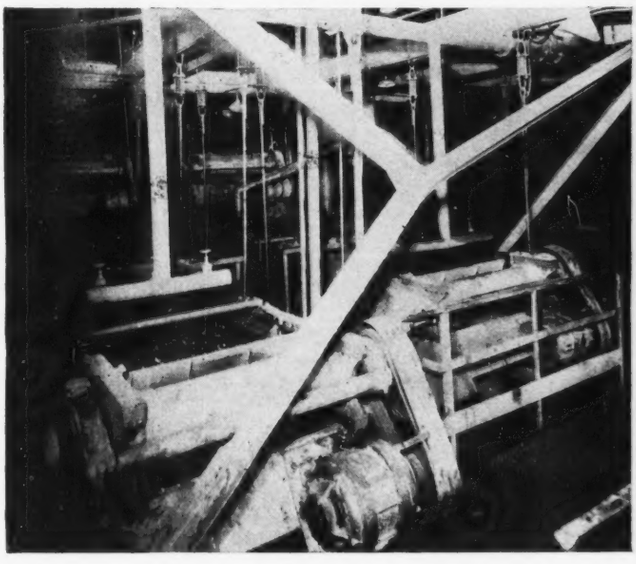
The excess medium from both concentrate and tailing drainage screens passes into surge tanks and is drawn off by 8-in. Wilfley manganese-steel-lined pumps, to be returned to the cone as shown on the flowsheet.

Washing Screens—The ore and waste particles leave the drainage screens coated with ferrosilicon and water sprays wash the ore and waste clean. The ferrosilicon and water, together with some fine ore, pass through the 2-mm. punch-plate decks into sumps.

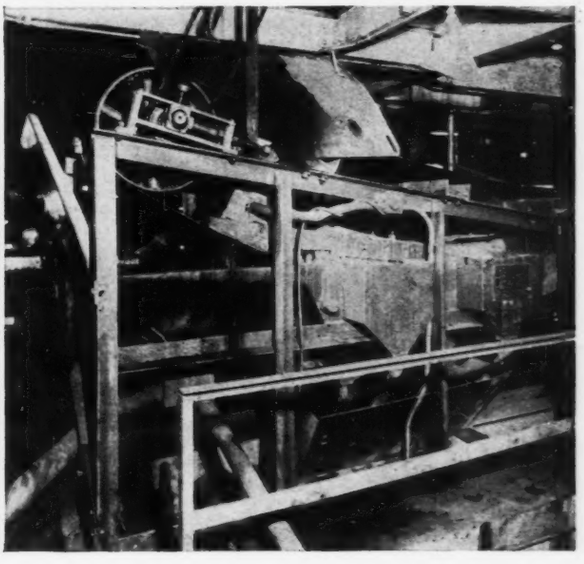
The concentrate washing screens are 5x16-ft. and the tailings washing screens are 4x16-ft. Nordberg flat-deck vibrating screens.

The Cleaning Circuit—The wash water and solids from the sumps are pumped to the cleaning circuit by means of Hydroseal rubber-lined pumps. The pump lines discharge through stainless-steel nozzles on either side of which are boxes, each of which contains two pairs of Alnico blocks arranged for polarity so that the flow

The medium drainage screens above. Below are the washing screens



One of the Crockett magnetic separators used for cleaning the ferrosilicon medium



of material from the pump line penetrates two concentrated magnetic fields. In so doing, a polarity is established in each ferrosilicon particle. This causes a flocculation of particles and causes rapid settling.

Primary Thickeners — The magnetized material is settled in 16-ft. diameter Eimco thickeners, the overflow of which passes to a 50-ft. thickener outside the plant. The wash water entering these primary thickeners contains about 2 per cent solids and the underflow about 15 per cent solids. These thickeners are the main source of medium storage.

Primary Thickener Pumps and Primary Magnetic Separators — The thickened pulp is pumped by 3-in. Wilfley manganese-lined pumps into 36-in. wide Crockett-type electromagnetic separators. Here the ferrosilicon is cleaned from non-magnetic material. The overflow of these units flows to the 50-ft. thickener and the clean ferrosilicon flows to 10-ft. thickeners.

Cleaner Magnetic Separator—The sands from the primary magnetic separators flow into a magnetic separator 24 in. wide and of the same type. The overflow of this unit also returns to the 50-ft. thickener, the sands go to the fines-treatment unit, and the clean ferrosilicon is sent to the 10-ft. thickeners. This separator also treats sludge from the 50-ft. thickener.

Secondary Thickeners—These thickeners are 10-ft. in diameter and are used to reduce the water content of the pulp prior to final thickening in Akins-type specially designed thickening units. The overflow of these 10-ft. thickeners also flows to the 50-ft. thickener.

Akins Thickeners—These screw-type thickeners have 24-in. spirals and raise the specific gravity of the cleaned ferrosilicon pulp to that desired (usually from 3.5 to 3.6). The overflow of these spirals passes into the wash-water sumps.

Demagnetizing—The thickened product from the Akins unit is dropped through alternating-current demagnetizing coils and the residual magnetism of the ferrosilicon particles is thereby destroyed. This medium then flows directly to the separating cones.

The 50-Ft. Thickener—This thickener is the final protection against loss of medium. The overflow is pumped to the screen sprays in closed circuit and the underflow pumped to the cleaner magnetic separator by a 3-in. Wilfley manganese-steel-lined pump.

Clean-up and New Medium—The basement has a concrete floor sloping to the boot of a clean-up bucket elevator. Any spillage as well as make-up medium is washed into this boot. The elevator discharges onto the tailing screens for removal of refuse and the medium enters the circuit via the tailings wash water.

Density Control—Massco density indicators are used to indicate the specific gravity of the discharges of the 8-in. Wilfley medium circulating pumps. The indicators control motors which raise or lower the spirals in the Akins thickeners, thereby controlling the gravity of the cleaned medium returned to the cones. This eliminates the necessity of manual measurement and control of specific gravities.

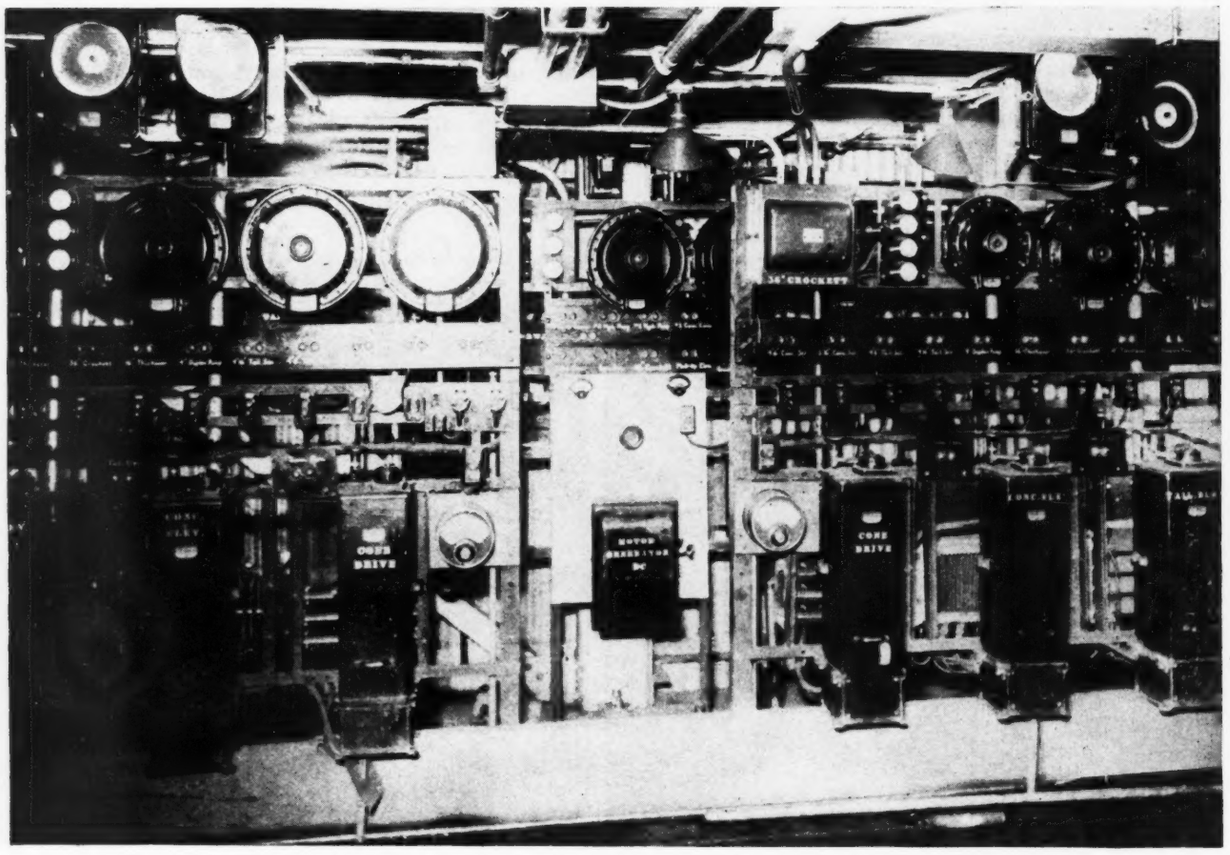
These units are housed in an all-steel building and during 1939, while in the stage of development, treated over 300,000 long tons of feed. During 1940 upwards of 1,000,000 long tons of feed will be treated, which definitely removes the ferrosilicon sink-and-float process from the experimental stage to the status of commercial practice.

The cost of operation and investment per ton are very close to the figures for jig practice, whereas results are superior on the sizes treated as shown heretofore.

In non-ferrous fields, the ferrosilicon sink-and-float process will find application in the saving of crushing costs, since the increased efficiency allows treatment at coarser sizes. Here it will be used primarily as a rougher process to be followed by some finishing method of concentration, such as flotation.

The process is also being developed to treat ores down to 20 mesh or lower.

Electric control panels for the two-unit sink-and-float plant at the Harrison No. 3 concentrator



Latin America and Our Strategic War Materials

Its present known resources of these commodities can be drawn upon and may be amplified by intelligent prospecting

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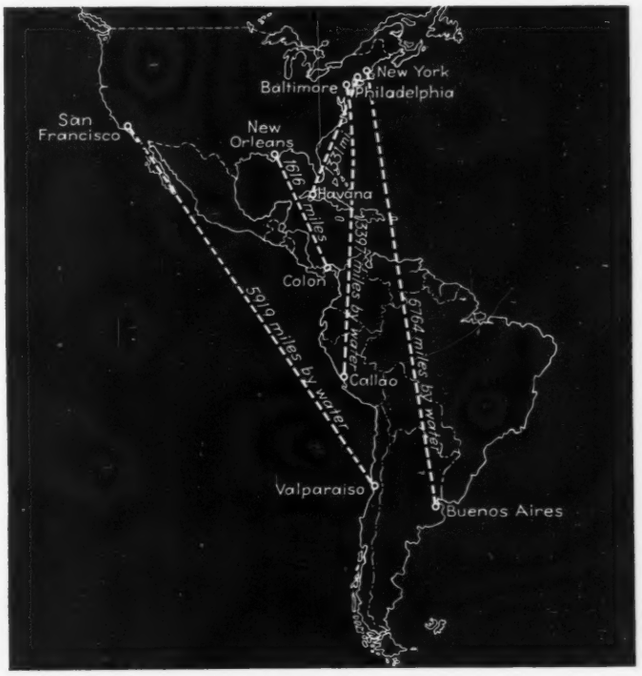

THE UNITED STATES is rich in minerals, and probably no other country is so nearly self-sufficient from the mineral point of view. Yet our country is poor in tin and industrial diamonds and must supplant with imports its inadequate production of certain other mineral products, notably antimony, long-fiber asbestos, chromite, fine crystalline graphite, manganese, mercury, rock crystal, certain grades of mica, and tungsten. These are all essential to industry in normal times and are particularly important today, with a great armament program on our hands.

The Procurement Division of the Treasury Department has already begun to purchase stocks of certain of these materials (notably tin and chromite and manganese and tungsten ores), but, even so, we must look to outside sources to save the stock from depletion.

Products of Latin America in part duplicate our own, but these countries do produce certain of the strategic minerals in which we are deficient and are capable in many instances of a larger production. As Latin America is not highly industrialized, in most cases she is in a position to export such of these minerals as she produces. Manganese ore, however, is needed by Argentina's glass industry and part of her tin is used locally; a little mercury, the product of Peru and Mexico, is consumed at home; Mexican tin is largely used as bearing metal locally, and a considerable part of the Brazilian diamond production is cut by and sold to the Brazilians, great lovers of gems.

Naturally, all statements as to possible imports of minerals from South America are predicated on the supposition that ship lanes to Latin America will remain open and that its governments and citizens are willing to play ball with the American Government and the American business man. It, however, must be remembered that distances are great in Latin America, Buenos Aires being farther from New York than are the Caucasian manganese ports.

The Spanish prospector was capable in his chosen field, finding silver and gold deposits. The average Latin American prospector, however, had little knowledge of mineralogy, and unless a mineral was heavy or had a metallic lustre, a valuable ore may well have escaped his notice. To expect to locate important outcrops of gold or silver ore in Latin America would brand one as an optimist. On the other hand, important deposits of certain of the strategic minerals may well remain undiscovered.

To date of writing at least, the prices of the strategic minerals have advanced an average of about 35 per cent from pre-war levels. Peak prices in the last World War were, on the other hand, three times those of midsummer 1939. The present mercury prices and, to a less degree, those of manganese and chromite are high enough to intrigue some venture dollars, but still higher prices must exist in most of these products before marked increased production in Latin America is to be expected. The temporary reduction of the tariffs on manganese and tungsten ores, mercury, crystalline graphite, and the larger sizes of mica, originating in Latin America, might well be considered as a stimulus to increased production.

In 1918 the United States consumed about 72,550 long tons of tin and in 1937, the peak year, over 87,800 tons. American mine production is practically nil: in normal times, we import all of our tin, the concentrates being smelted abroad. In the World War, we had two smelters here which, in 1920, produced some 14,500 tons of tin, but they were shut down soon thereafter. At present two experimental reduction works are making trial smeltings of Bolivian concen-

trates. Bolivia has the world's most important lode tin mines and normally produces concentrates containing some 25,000 tons of metal. Although the natives smelt a small percentage of the production, most of the concentrates are reduced in Europe. The present mine capacity is about 36,000 tons a year, a capacity attained some fifteen years ago but now perhaps impossible to approach, due to the labor situation. If the infant American tin-smelting industry prospers, Bolivia for some years will be the principal source of concentrates, provided the international tin cartel does not curtail production too drastically.

Tin in Argentina

Northwestern Argentina is a growing tin field, with a present production of about 2,000 tons a year—part from gravel and part from lode mines. About half of the production is smelted locally, and in 1938, 482 tons of tin was exported to the United States. With high prices, the reported reserves might justify an appreciably greater production. For years many tin occurrences have been known in north-central Mexico, but considerable American and some local capital has not developed the industry much beyond the country's needs of babbitt metal. The ore is largely recovered from stream gravels; a little from narrow veins. In certain years we import one or two hundred tons of Mexican tin, and no large increase is to be expected. Peru is a small producer of this metal, the production from 1936 to 1938 varying from 24 to 97 tons. The optimist might hope that Latin America, in the future, will furnish us with ore for from a quarter to a third of our consumption; provided we had smelters to treat it. For the rest, we must look elsewhere. The tin situation is critical.

Manganese ore is essential in steel making, forms important ferrous alloys, and is used by battery makers and in the chemical, glass, and ceramic industries. In 1937, a fairly good year in the steel industry, over 1,000,000 tons of good-grade manganese ore was used. Normally, about 90 per cent of our needs is procured from imports—Russia, Gold Coast, Cuba, India and Brazil ranking in that order. The United States produces a fair tonnage of low-grade ore and a smaller tonnage of good-grade ore. Under the stimulus of high prices, our country might supply a little over one-third of its needs. Cuba has always supplied the United States with a certain amount of manganese — more in times of high prices, and less in times of low prices. Its production in recent years, however, has been increased and stabilized by the important mining operations of the Cuban-American Manganese Corporation, a subsidiary of the Freeport Sulphur Company. From its large reserves of low-grade ore (about 18 per cent), this company produces, by milling, a high-grade product. Recent annual productions have been about 100,000 tons of sinter and 50,000 tons of blast furnace ore. The plant treats 1,000 tons of ore a day, but ore reserves are sufficient for doubling or even quadrupling the plant. In addition, in times of high manganese prices, other Cuban producers might add a further 50,000 tons. We can, therefore, look to Cuba to furnish us some 200,000 tons, and in two years' time, under certain conditions, considerably more. Cuba is, of course, only a short distance off the Florida coast and a ship lane to America could probably be maintained by the navy under almost any conceivable conditions.

Brazil has manganese deposits in several of its States, Minas Geraes, Bahia, and Matto Grosso. Minas Geraes has been an important producer; Bahia much less so. The ores carry a good manganese content and are relatively free of objectionable impurities. Production began in 1894 and in 1916 reached 495,172 tons, and in that year the United States imported 512,517 long tons from Brazil. In 1938, production exceeded 220,000 tons. Morro de Mina, owned and operated by a subsidiary of the United States Steel Corporation, is equipped to produce 1,000 tons a day and presumably still has large reserves. There are other deposits in Minas Geraes that, in times of high prices, can be operated at a profit. A large deposit exists at Urucum, Matto Grosso, but it is far inland. Another large deposit is reported to exist in the northwestern part of the State of Maranhao. With high manganese prices, imports into the United States from Brazil should again reach 400,000 to 500,000 tons.

Argentina has several manganese deposits, but though mining costs are not excessive, transportation costs are high. In normal times, her production is but a few hundred tons a year, which is readily absorbed by Argentina's glass and other industries. During the World War and immediately thereafter, Argentina exported a little manganese to the United States, but even with high prices, no large contribution can be expected from this source. Mexico is also a small producer of manganese ore, and high prices might lead to small imports. The same observation applies equally to Costa Rica and to Chile, which in 1937 produced 13,015 tons. Ecuador, Colombia, and Panama might furnish some manganese ore, Panama being by far the most promising of the three and, indeed, it might become of some importance. British Guiana is said to have one rather large deposit of medium-grade ore; Uruguay has large deposits of low-grade ore, and Paraguay some high-grade but rather inaccessible deposits. Unless important new mines are developed, Latin America, exclusive of Cuba and Brazil—even with high manganese prices—could scarcely export to America more than 25,000 tons a year. The necessity of pushing production in Cuba and Brazil is evident, in the hope of increasing our imports from these important manganese-producing countries.

In 1937, a rather good year in the steel industry, our country imported somewhat over 550,000 long tons of chrome ore, American mines furnishing some 2,250 tons additional. Of the Latin American countries, Cuba alone is a consistent source of supply, it furnishing normally about 18 per cent of the imports. Chromite is widely distributed on the island, notably in the provinces of Camaguey, Oriente, and Matanzas. Practically all of Cuban ore is used for refractory brick and cement. Higher prices would stimulate production, but the chances of finding high-grade ore are not brilliant. Bahia, Brazil, has considerable reserves of chromite of, on the average, rather low grade. During the World War, several of the deposits were worked, 13,500 tons having been produced in 1918. Costs are relatively high, particularly that of transportation, and after peace had been declared, mining practically stopped. Present prices should furnish a modest margin of profit, and a small tonnage of Bahia chromite should soon again reach our shores. The chromite deposits of Guatemala were discovered in 1915, and that country shipped a few thousand tons of high-grade ore to the United States during the last war (2,500 tons in 1918). Production apparently had ceased by 1935. Twenty years ago a little chromite was being produced in Coahuila and Durango, Mexico, and, during the World War, Nicaragua shipped a little to the United States. Under the stimulus of higher prices, we can expect somewhat increased imports of chrome ore from Latin America, but scarcely more than a quarter of our needs.

The Quicksilver Situation

Due to the virtual monopoly of the world's mercury supplies by Spain and Italy, the metal has doubled in price since hostilities began—indeed, it has enjoyed a greater rise than any of the other strategic minerals. The United States consumes yearly from 25,000 to 35,000 flasks (76 lb. each), of which some 17,000 flasks are produced domestically. Since the sensational rise in price, old mines have been refinanced and have been reopened or are in that process; indeed, in April, 1940, the production was at the annual rate of over 30,000 flasks, a close approach to the peak pro-

duction (1917) of 35,683 flasks. With the armament program in full swing, we would have to import a further 5,000 to 10,000 flasks (1939 imports, 3,499 flasks). From 1935 to 1938, we have annually imported from Mexico an average of 1,104 flasks, her production during the same period having averaged 6,250 flasks (8,519 in 1938). Mercury occurs in practically all of Mexico's mining states and the present high prices are certain to stimulate production. Unfortunately, it is said that the property of one of the largest producers, Explotadora de Mercurio de Huitzuco, S.A., in Guerrero, an American company, after a long strike is to be taken over by the miners. The company operated a 100-ton flotation mill and is said to have had important ore reserves.

The most famous mercury deposit in the Western Hemisphere, Huancavelica, Peru, has not produced much mercury for over one hundred years. For the past twenty years, a certain amount of development work has been done on it, and it is stated that an important American mining house is now examining the property. In 1934, Bolivia produced 557 flasks, but production apparently ceased by 1938. Brazil, Chile, Colombia, and Ecuador at one time produced a little mercury, largely used in the local precious-metal industry. Cinnabar in boulders and in place occurs on the Maroni River, Dutch Guiana, but the importance of the discovery is unknown. In conclusion, our own production, backed up by Latin American imports, will probably more or less suffice for our armament needs.

The United States is more nearly self-sufficient in tungsten than in tin, chromite, or manganese. In years of normal consumption, we could, if forced to do so, fill our own requirements, but if consumption jumped, as it did in the World War, to 10,000 to 15,000 tons, we would have to import from one-half to two-thirds of our needs. Bolivia is the most promising source, and with high prices could probably duplicate her 1917 exports of 4,150 tons, although this would require doubling her present production. There are numerous deposits in the tin-producing area on the high plateau, and in fact part of the production is a byproduct of tin mining. The mines, on the average, are small, wolframite being the principal ore, and the product is sold to ore buyers. Peru has probably equally important reserves, but needs high prices to operate profitably, as the mining methods are primitive and transport to the coast is largely by llamas. By the close of the World War, she was producing almost 2,000 tons of concentrates, of which she exported 80 per cent to the United States. The principal deposits are in the Departments of Ancachs and La Libertad and others exist in the Departments of Puno and Ayacucho. Argentina, even in normal years, exports a little wolframite and scheelite to the United States and in 1917 she exported almost 1,000 tons of high-grade concentrates. The principal deposits are in north-central Argentine in the Provinces of San Luis and Cordoba. The deposits are small but rich. Given time and high prices, the 1917 record could presumably be duplicated. Mexico produces a little tungsten ore, largely in Sonora; her possible contribution would be small. Colombia, Chile, and Brazil might add a little. In short, with the Latin American added to our own production, we might, with high prices, have at our disposal from 11,000 to 12,000 tons of concentrates, and if this did not suffice, we could substitute, for certain uses, enough molybdenum ore to make up the difference.

Mexico and Bolivia for Antimony

In 1937 we consumed some 18,000 tons of primary antimony; in less prosperous years, from 7,000 to 15,000 tons. Domestic mines produce about one-twentieth of this. Mexico and Bolivia, however, produce enough metal to satisfy America's demand should our imports from China be cut off. In the northern half of Mexico there are a number of deposits and, notwithstanding the fact that the principal producer was shut down in 1938 by labor troubles, high prices would undoubtedly result in increasing the production.

Bolivia has a number of antimony deposits widely scattered over the Andean highland. The producers are small units, a type the production of which is greatly stimulated by high prices, as is indicated by the figures of production during the World War —namely: 1914, 102 tons; 1915, 9,859; 1916, 15,077 tons; 1917, 12,800, and 1918, 4,770 tons. Probably many potential producers are still undiscovered. Peru and, to a less extent, Argentina and Chile, in times of high prices, also produce a little antimony. The antimony situation is less disturbing than that of some of the other strategic minerals, particularly as, if necessary, substitutes could be used.

If the Belgian Congo and Rhodesian sources of cobalt supply were shut off, we could continue to import some metal from Canada. Chile and Bolivia each produces a little cobalt and the metal is reported to occur in Jalisco, Mexico, in Argentina, and in several of the Peruvian departments. We cannot look to Latin America for much help in the cobalt problem but, on the other hand, other metals could be substituted for it in most of its uses.

We also have no nickel, but across a friendly border is the Sudbury district, which produces 90 per cent of the world's production of that metal. It is almost inconceivable that the United States cannot procure from this source its needs, although we should realize that a few well-directed bombs might temporarily cut off both the Canadian and our own source of supply. Brazil produces a little nickel, a mere one-half of 1 per cent of our country's needs. The Brazilian Geological Survey, however, estimates that in a deposit at São José de Tocantius, in the State of Goyaz, are over 2,000,000 tons of nickel assaying 5 per cent or better. The deposit is far inland but is within about 40 miles of a navigable river. A considerable amount of test pitting has been done and a couple of years ago it was stated that a small reverberatory furnace, which should make two to three tons of ferro-nickel (60 per cent nickel), was to be erected. Other smaller nickel deposits are reported to occur in Brazil. Chile once produced a little nickel and it is known to occur to a limited extent in Peru. Eventually some nickel also may be produced in Cuba.

Brazil has important mica deposits and could probably satisfactorily make up for our own shortage in high-grade sheet mica. As the World War waned, her production was well over 100 tons and in 1936 it exceeded 230 tons. Her potential production is considerably more. Argentina is almost as large a producer as Brazil, but the product, though desirable, does not average as good. Peru, Bolivia, and Guatemala ship some mica to the United States, and Mexico and Venezuela are small producers.

Though long-fiber asbestos is reported from Latin America, the deposits are not believed to be important. Mexico produces a little high-grade graphite from time to time.

The United States imports most of its industrial diamonds from various African producers, through London, but Brazil produces some fine bort and a little ballas and has a monopoly on carbonado production. British Guiana produces some bort. Though these two countries would not supply our needs, their production, if directed toward our country, would be important to us. Brazil produces much fine rock crystal essential in the construction of many scientific instruments used both in war and in peace. It is also a producer of other gems such as tourmaline, which has a value in certain instruments. Brazil is also an important source of zirconium ores, particularly baddeleyite.

In résumé, the Latin American countries most capable of supplying the United States with strategic minerals are Brazil, Bolivia, and Cuba; Argentine, Mexico, and Peru are of less importance, and British Guiana, Chile, and Panama might supply their modicum. Five years hence, one of these countries might well become important.

Zinc Ore Reserves of the World

A compilation from available authentic sources, showing tonnages and grades in the United States and in other countries

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Director
Callahan Zinc-Lead Company
New York

ZINC is commercially the newest and, at least in point of volume for weight, the cheapest of the non-ferrous base metals. As such it has achieved a position of importance in modern industry comparable with those of its companion metals copper and lead. Its consumption growth has been unusually rapid, but the quantity available in the earth's crust has thus far been sufficient to meet the world's demands.

In 1800 the metal was almost unknown commercially, but in the following 138 years the world consumed 53,000,000 short tons of zinc, compared with 60,000,000 short tons of copper. Over 98 per cent of the indicated zinc consumption has taken place since 1806. Improvements in methods of ore treatment as well as discovery of new ore deposits have contributed to the expanding production of the metal.

Obviously, a commodity of such great importance must interest mineral economists and technologists alike. Moreover, the probable reserves of zinc ores must be a matter of vital concern, not only to great mining organizations engaged in the production of zinc, but also to consumers of the metal, and to areas in which zinc mining and smelting are conducted.

How much zinc ore remains in the earth's crust? The answer, of course depends on the definition of ore, which will vary with the demand for the metal and general economic conditions. The answer depends also on the facility with which one may have access to many records; and since such access is less than full and complete, the answer itself must be less than perfect. Nevertheless, I have undertaken to compile from a great variety of sources an estimate of the world's zinc ore reserves. I am humbly cognizant of the difficulties of the task, and welcome comment from others who can contribute information that will make the record more complete.

Ore reserves may be defined as that material which will yield sufficient metal to produce a profit at a given price. As the development of ore reserves is an undertaking usually entailing years of effort, it follows that the long term price of the metal produced is of first importance in the plans of mining companies.

Since World War I, maximum peace-time consumption of zinc in the United States has been about 600,000 tons. It is a matter of record that whenever consumption has exceeded 50,000 tons per month for a sufficient number of months, the market price has equalled 6¢ per pound or better.

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Table I—Zinc Ore Reserves in the United States, 1938

Estimates of Probable Reserves of Ore, Metallic Content and Milling Capacity, by Districts, covering the more important mines

Mine	Owned by	Probable Reserves, Tons	Zn, %	Pb, %	Cu, %	Ag, oz.	Milling Capacity Per Year, Tons Ore
Tri-State							
All mines		150,000,000	4.0	0.8	.....	.....	15,000,000
Rocky Mountain							
Montana							
Elm Orlu, Orphan Girl, Others	Anaconda (a)	20,000,000	6.0	.....	(b)	(b)	.....
Block P	St. Joseph	500,000	5.5	6.5	.....	10	125,000
Butte & Superior	(Closed)	133,000	13.0	1.3	.....	6	.....
Idaho							
Morning	Federal	1,200,000	6.0	9.0	.....	4	380,000
Page-Black Hawk	Federal	360,000					
Star	Sullivan	5,000,000	8.0	5.0	.....	3	200,000
Bunker Hill & Sullivan	.....	5,000,000	5.0	7.0	.....	3	500,000
Day properties	Hercules, etc.	1,000,000	5.0	7.0	.....	3	200,000
Washington							
Metaline Falls	Metaline	3,000,000	13.5	2.5	.....	.....	.....
Pend Orielle	Pend Orielle	2,000,000	10.0	2.0	.....	.....	300,000
Colorado							
Eagle	N. J. Zinc	5,000,000	12.5	2.5	.....	.....	225,000
Sunnyside	U. S. Smelting	650,000	3.0	4.0	.....	4	330,000
Utah							
Bingham Canyon District	U. S. Smelting	5,000,000	10.0	11.0	.....	5	500,000
	Anaconda	1,000,000	18.5	8.0	.....	7	.....
Park City District	Silver King	3,500,000	11.0	15.0	.....	18	250,000
Nevada							
Tybo	Bunker Hill, Treadwell Yukon	230,000	5.0	6.0	.....	10	100,000
New Mexico							
Pecos	Am. Metal	650,000	17.0	5.0	.....	3	150,000
Willow Creek	N. J. Zinc, Illinois Zinc, Others	2,000,000	7.0	.....	.....	.....	175,000
Arizona							
United Verde	Phelps Dodge (a)	12,000,000	7.0	0.2	0.6	2	.....
Total Rocky Mountain		68,223,000	8.0	.....	.....	.....	3,435,000
New Jersey							
Franklin, Sterling	N. J. Zinc	10,000,000	19.0	.....	.....	.....	925,000
Appalachian							
New York							
Balmat, Edwards	St. Joseph	9,000,000	12.0	1.0	.....	.....	350,000
Virginia							
Wythe County	N. J. Zinc	6,000,000	5.5	1.5	.....	.....	450,000
Tennessee							
Mascot, Jarnegin	Am. Zinc Lead	7,000,000	3.2	.....	.....	.....	850,000
Darvis	U. S. Steel	2,500,000	3.2	.....	.....	.....	250,000
Total Appalachian (excluding New Jersey)		24,500,000	7.0	.....	.....	.....	1,900,000
Grand Total (approx.)		250,000,000	6.0	.....	.....	.....	21,000,000

(a) Development deferred. (b) Not available.

Table I-A

District	Ore Reserves, Tons	Metallic Zinc, Tons	Market Price for Slab Zinc Necessary for Profitable Production in Past Years
Tri-State	150,000,000	6,000,000	6.00c. plus per lb.
Rocky Mountain	68,275,000	5,400,000	5.25c. per lb.
New Jersey	10,000,000	1,900,000	Enter into operations of large, fully integrated fabricating companies.
Appalachian	24,500,000	1,700,000	
Wisconsin	.....	.....	Of no present economic importance.
Total (approx.)	250,000,000	15,000,000	5.00–6.00c. per lb.

On the other hand, when the market price falls below 5¢ per pound, mine production contracts sharply, indicating that 5¢ is the probable low point of profitability in United States zinc production if more than minimum requirements are needed. Such limitation is confirmed by the figures in the following table of long-term prices. Reliable price data are available for the past 65 years, and a price summary is as follows:

	Average Yearly Price at N. Y., Cents per Pound
1875-1914—40 years	5.18
1915-1920— 6 years	10.19
1921-1930—19 years	5.72
Average for 65 years	5.80
Eliminating the war period—59 years	5.36

Thus the price limits for the definition of zinc ore seem to lie within the range of 5 to 6¢ per pound. Mining companies, therefore, are likely to consider as zinc reserves only ores of sufficient grade to yield a profit at the 5 to 6¢ range when treated by most recent effective metallurgical processes. At 10¢ per pound, United States reserves might prove to be almost inexhaustible; at 3¢ they would probably be non-existent.

Table I showing United States mine reserves of zinc ore is based on the miner-metallurgist reckoning of ore supplies rather than that of the geologist interested in mineral occurrences. It summarizes available data from published company information and other sources considered reliable.

In recapitulation, and again pointing out the price element necessary to define ore, the United States total present reserves of metallic zinc may be stated as in Table 1-A.

It will be observed that the Tri-State district of Missouri-Kansas-Oklahoma has by far the largest tonnage of ore reserves, with the Rocky Mountain region second and the Appalachian third. The grouping of scattered Rocky Mountain and Appalachian reserves is arbitrary, as is also the separate consideration of New Jersey. The Wisconsin district is of negligible importance as to reserves.

How long will these reserves last? The largest annual production of primary zinc from domestic ores was 612,000 tons, in 1929. More recently the annual rate has averaged about 500,000 tons. At these rates of production the estimated reserves might be exhausted in 25 to 30 years, or even sooner at conceivably higher rates. On the other hand, the estimates relate only to reserves that could be profitably treated at approximately the prices indicated. There would be wide variations in actual reserves at lower or higher market prices.

Table II relates to zinc ore reserves outside the United States. It is far from complete, because it includes only those mines whose estimated reserves indicate a metallic content of at least 100,000 tons. Zinc ore and concentrates are being produced currently from numerous small properties not included in the table. Omission also is made of some large companies that draw their ore supplies from a number of smaller producers. For example, through its Mexican subsidiaries the Howe Sound Company produced in 1938 concentrates containing an estimated recoverable 55,000 tons of metallic zinc.

As the company's activities now cover a wide district rather than a single compact mining property, no attempt is made to block out ore reserves for more than a few years ahead of production, and no reserve figures are made public.

It is likely, therefore, that effective known reserves of zinc ore outside U.S.A. would total at least a third again as much as the totals of Table II. That would indicate:

Long Tons Ore	Zn, %	Long Tons Zinc	Est. Recoverable Zinc per Year at Present Mill Capacity, Long Tons
256,000,000	12.5	32,000,000	1,550,000

From Tables I and II we can derive a summary in Table III that will show the world position with respect to zinc ore reserves.

Table II—Zinc Ore Reserves Outside the United States, 1938

Estimate of Probable Reserves of Ore, Metallic Content, and Potential Annual Production at Present Milling Capacity, covering only the more important mines

	Long Tons Ore	Zn, %	Pb, %	Ag, oz.	Long Tons Zinc	Est. Recoverable Zinc Per Year at Present Mill Capacity, Long Tons
The British Empire						
Africa						
Rhodesia Broken Hill	1,000,000 500,000 (a)	26.0 33.0	8.0 24.0	....	260,000 165,000	25,000
Australia						
Broken Hill district	15,000,000	11.0	14.0	6.0	1,650,000	132,000
Lake George	2,880,000	12.9	7.5	2.2	372,000	.....
Mount Isa	15,000,000	8.0	6.8	4.0	1,200,000	54,000
Rosebury	3,000,000	20.0	6.0	7.0	600,000	36,000
India						
Burma Corp.	3,900,000	15.3	25.5	20.0	600,000	61,000
Canada						
Sullivan	36,000,000	12.5	10.5	3.0	4,500,000	213,000
Hudson Bay	25,000,000	4.0	2.0 (b)	1.3	1,000,000	70,000
Errington	5,000,000	4.5	1.0	1.6	225,000	.....
Reeves-McDonald	2,000,000	7.0	2.0	0.5	140,000	.....
Normetal	700,000	14.0	2.3 (b)	4.0	100,000	12,600
Newfoundland						
Buchans	7,150,000	16.3	7.3	3.6	1,150,000	49,000
Total Empire	117,130,000	10.2	.....	.....	11,962,000	652,600
Europe						
Bleischarley (Pol.)	10,000,000	17.0	1.5	....	1,700,000	45,000
Bleischarley (Ger.)	10,000,000	22.0	3.5	....	2,200,000	100,000
Ammeberg (Swed.)	5,000,000	20.0	8.0	....	1,000,000	37,000
Reocin (Spain)	9,000,000	15.0	2.5	....	1,350,000	38,000
Trepca (Yugo.)	1,750,000	10.5	11.5	3.0	184,000	50,000
Altenburg (Ger.-Belg.)	3,000,000	7.0	3.0	2.5	210,000	11,000
Raibl (Italy)	2,000,000	14.0	2.0	....	280,000	28,000
Total Europe	40,750,000	17.0	....	....	6,924,000	309,000
Siberia						
Ridderakaya	2,613,000	15.0	8.5	?	542,000	(c)
Salarski	2,710,000	9.0	1.0	?	244,000	(c)
Tstiukhe	1,016,000	12.9	10.3	4.0	131,000	(c)
Total U.S.S.R.	7,339,000	12.5	....	....	917,000	75,000
Mexico						
San Francisco	1,550,000	9.6	7.6	6.5	150,000	50,000
Parroquia Magistral	2,000,000	5.5	1.3	5.7	110,000	6,000
South America						
Huanchaca (Bolivia)	3,000,000	12.0	4.0	16.0	360,000	14,000
Matilde (Bolivia)	2,000,000	20.0	3.0	2.5	400,000	(c)
Salvador (Bolivia)	1,500,000	20.0	?	12.0	300,000	(c)
Casapalca (Peru) (Cerro de Pasco) (d)	10,000,000	18.8	8.0	5.0	1,800,000	20,000
Aguilar (Argent)	8,000,000	14.0	9.0	8.0	1,120,000	20,000
Total Mexico and South America	28,050,000	15.1	....	....	4,240,000	130,000
Combined Totals (approx.)	193,000,000	12.5	....	....	24,000,000	1,167,000

(a) Direct treatment ore. (b) Copper content. (c) Not available. (d) Figures are not official.
Note: This table is being revised on the basis of officially published figures for the close of the year 1938.

Table III—Summary of World Reserves

	U. S. A.	Rest of World
Est. reserves of zinc ore, long tons	223,000,000	256,000,000
Est. average zinc content, per cent	6.0	12.5
Est. metallic zinc content, long tons	12,400,000	32,000,000
Est. annual milling capacity		
A. Long tons of ore	18,750,000	16,000,000
B. Metallic zinc content	1,125,000	2,000,000
C. Production based on 75% metallurgical recovery	850,000	1,500,000
Largest annual production	(1929) 612,000	(1938) 1,150,000
Latest production	(1939) 480,000	(1938) 1,150,000
Apparent length of life of present reserves		
A. At highest rate of production to date	18 yr.	21 yr.
B. At latest rate of production	(1939) 22 yr.	(1938) 21 yr.

New Cornelia Today

An account of current operations at this porphyry copper enterprise of Arizona

John B. Huttl
Assistant Editor

DURING the early part of March I visited the New Cornelia enterprise of Phelps Dodge Corporation at Ajo, in Pima County, Ariz. This is the southern terminus of the Tucson, Cornelia and Gila Bend R. R., a 43-mile stretch of track connecting with the main line of the Southern Pacific at Gila Bend. By automobile, Ajo can be reached via State Highway 85, the distances from Gila Bend and Tucson being 44 and 138 miles respectively. The region is one having a sub-tropical, dry climate and deep wells are depended upon for water for the use of the town and the mining plants. Although in the history of its development the New Cornelia undertaking differs but little from the other large porphyry copper mines in the Southwest, a brief résumé of the more important steps in the evolution of the mining and concentrating methods employed may be of interest as a preliminary to the description of the current practice.

Serious and large-scale development of the holdings was begun in 1911, when Calumet and Arizona Mining Company under the late Col. John C. Greenway and Dr. L. D. Ricketts undertook a comprehensive diamond-drilling campaign. Extensive experiments to determine an economic way of treating the carbonate ore followed, and culminated in the erection and operation of a 5,000-ton leaching plant in 1917. Pilot plant work on sulphide ore was started in 1919 and the initial 5,000-ton concentrator that resulted was completed in 1924. Since then, addition of new sections and other improvements have brought the total mill capacity up to 20,000 tons. Phelps Dodge acquired the property in 1931.

The monzonite porphyry orebody now being exploited about 1 mile southwest of the concentrator is of the disseminated type and measures about 4,000x2,300 ft. at an elevation of 1,700 ft. The major portion of it is hard and siliceous, and the principal copper minerals, which are finely disseminated in the ore, are chalcopyrite and bornite. Along the southern border of the monzonite a narrow zone of secondary chalcocite occurs. Traces of hematite, magnetite, molybdenite, pyrite, sphalerite, and tennantite are found. Mining is done in a pit about 3,800 ft. long, 2,900 ft. wide, and elliptical in shape. The benches, developed by 4½-cu.yd. electric shovels, average 40 ft. in height. Depth of the present pit floor below the average elevation of the rim is about 200 ft. Broken ore and waste rock are loaded by 8 electric shovels into 20-cu.yd. raise-door, steel dump cars and also into 30-cu.yd. drop-door steel cars, some of which have axleless trucks equipped with anti-friction bearings. These cars are hauled in trains of 6 cars of the 20-cu.yd. type or 5 cars of the 30-cu.yd. type to the crushing plant and waste dumps by steam locomotives and, prior to their removal to Morenci, Ariz., by four 1,000-hp. diesel-electric locomotives that were then under test.

Ore-waste ratio at present is about 1 to 1.2. Stripping on Arkansas Mountain, which rises near the center of the western rim of the pit, is accomplished with earth-moving units consisting of a 4½-cu.yd. electric shovel, a bulldozer, and four 22½-cu.yd. end-dump trucks. Train haulage in the pit is laid out on the spiral system, and the standard gage trackage in operation exceeds 20 miles. The main tracks running to the concentrator and waste dumps are laid with 90-lb. rail. The tracks (of 90-lb. rail) on the shovel benches are laid in panels of one rail length for ease in removal and relaying. A locomotive crane removes these panels before bank blasting, and subsequently replaces them. Shovel ramps, roadways, drilling areas, and benches for tracks are prepared by diesel-powered bulldozers. The waste dumps are carried at an average height of 75 ft. New grades for lining waste dumps are made by use of a spreader plow. Haulage distances from pit to mill and to the waste dumps are 2 and 2¼ miles respectively. The main-line tracks are laid on an adverse grade of 2 per cent. In the pit proper, ramp grades of 5 per cent are used to permit the empty trains to reach the shovel benches.

Primary drilling is done with electric churn drills, using 9-in. bits for benches more than 20 ft. in height. Wagon-type drills and tripod air drills are employed for primary drilling where the required depth of the hole is less than 20 ft. These units employ 1¼-in. round steel. Jackhammers with 1-in. round steel are used in secondary drilling, consisting of block-holing large boulders and toe-holing on the shovel benches. All drills use detachable bits. Drill changes in primary and secondary air-drill work are 4 ft. and 2 ft. respectively. The churn drills are actuated by 25-hp. 440-v. motors. Two men comprise a crew, and the footage per 8-hour shift is as follows: Churn drills, 50 ft.; wagon drills, 110 ft.; and tripod drills, 95 ft. On the 40-ft. benches the holes in general are spaced 12 ft. apart along the bank and 15 ft. back from the crest, depending on the ground. Depth of the churn-drill holes averages 46 ft. A bench area 1,250 ft. long and 50 ft. wide (including back break) requires about 110 holes, which is the average number fired at one blast. Granular powder, varying from 40 to 60 per cent for dry holes; 40-per cent gelatine for wet churn-drill holes and primary and secondary air-drill holes; and 60 per cent gelatine for springing air-drill holes are the customary explosives used. All primary blasts are detonated by Primacord, secondary air-drill holes with electric caps fired from a central switch station, and boulders at times are fired with fuse and caps. The average tonnage broken per primary blast is about 75,000, the explosives ratio being 4¼ tons per pound of powder. Material broken by churn-drill blasts averages 40 tons per foot of blasted drill hole, and that for air-drill blasts about 8 tons.

Auxiliary equipment serving the

The open pit of New Cornelia. From it in 1939 came approximately 6,000,000 tons of ore and 7,000,000 tons of waste. Rising near the center of its western rim is Arkansas Mountain, on the upper benches of which stripping is done with the aid of 22½-cu. yd. trucks, in contrast with the railroad haulage in use in the main portion of the pit

New Cornelia's concentrator, of 20,000 tons daily capacity, at Ajo, Ariz. In the foreground is a 275-ft. traction thickener

drilling sites includes a standard-gage powder car, railroad motor cars, a service truck equipped with hoist for distributing and handling drill bits and other supplies, a dump truck for transporting stemming, and a machine for loading churn-drill holes.

At the entrance of the pit are the modern drill-sharpening and repair shops and a garage. All buildings are of steel, with overhead electric cranes and a generous number of windows to provide air and light. Machinery for sharpening and tempering drills and for other repair work, and welding equipment are of latest design. Air for pit work and the shops is supplied by two twin and one single angle-compound compressors, distribution being effected through a 6-in. main connecting to a 4-in. pipe line, from which branch pipes lead to the different drilling sites in the pit. All lines are on the surface.

In the pit proper every measure has been taken to safeguard health and safety. Blasting shelters, switch houses, and electric water coolers are installed at different points, and road dust is kept down by a special sprinkler truck. Mobile servicing equipment includes a lubrication truck, supply and pick-up trucks, locomotive crane, and a number of railroad motor cars, one containing first-aid materials.

During 1939, about 6,000,000 tons of ore and 7,000,000 tons of waste were removed from the pit.

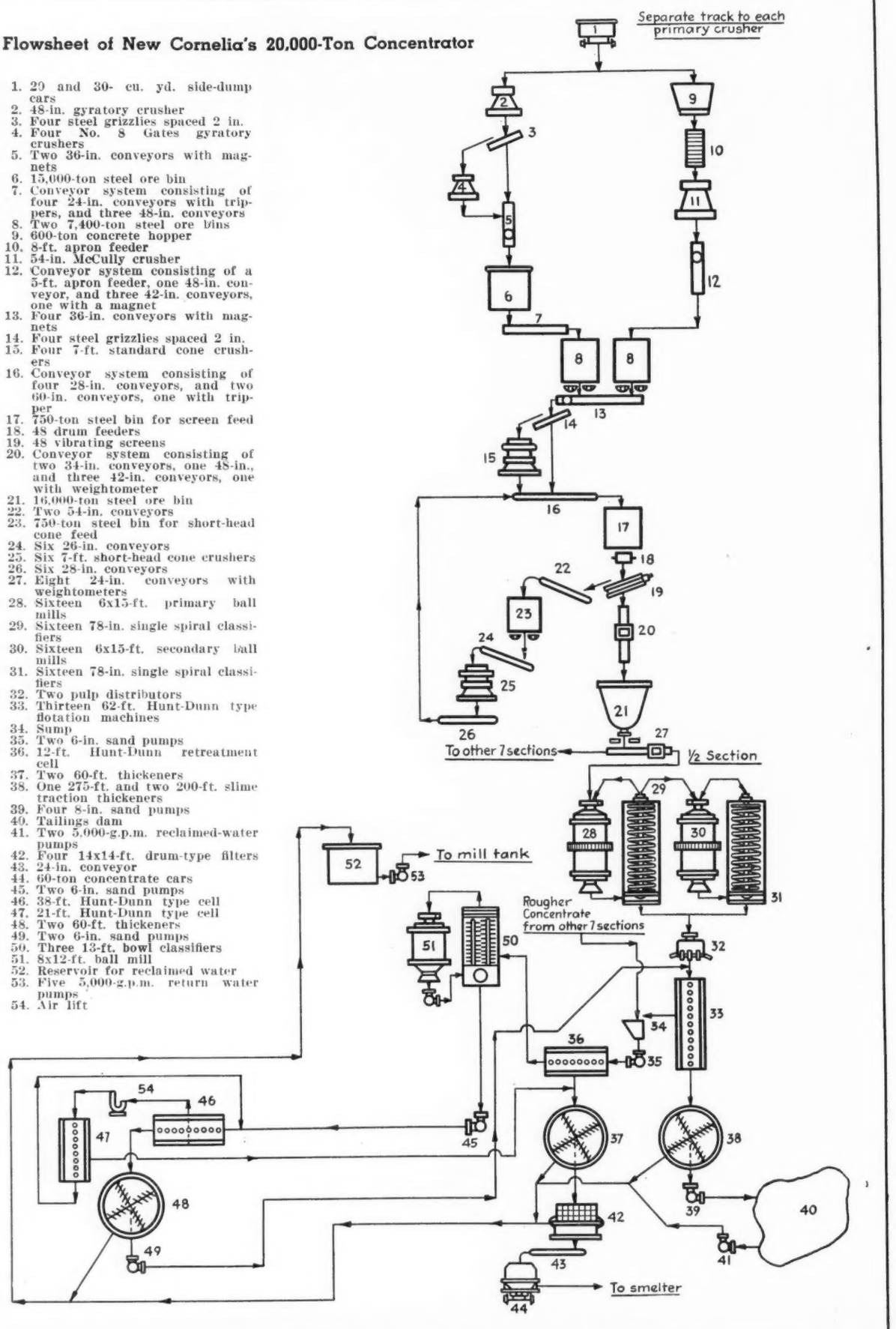
Treatment of the mined ore at the crushing and concentrating plants is graphically explained in the accompanying flowsheet. Numerous mechanical improvements have been made in both departments in recent years. For instance, gyratory crushers and rolls formerly used for intermediary and fine crushing have given way to standard and short-head cone crushers, and dust-recovery equipment has been enlarged and improved. At the concentrator, ball mills are now employed exclusively for primary grinding, a 200-ft. tailings thickener has recently been added to the dewatering plant, old classifiers replaced with spiral type units, and additional filters and air flotation machines installed. Test work on single-stage grinding, low-level mill, and rationing of ball charges is currently in progress.

Mine-run ore is crushed to about minus-4-mesh for mill feed in three stages. For primary crushing there are available a 54-in. McCully-type crusher, originally installed for handling sulphide ore, and a 4-in. gyratory crusher which reduced carbonate ore exclusively until leaching was discontinued. The 54-in. unit is served by a 600-ton concrete feed hopper and an 8-ft. manganese-steel apron feeder, the finished product, 6 to 8 in. in size, being delivered by a 5-ft. apron feeder to the belt conveyor system terminating at the two 7,400-ton steel bins of the coarse-ore storage plant. Ore fed direct to the 48-in. crusher drops after being crushed onto four steel grizzlies, having 2-in. spacing whence the oversize goes to four No. 8 Gates gyratories for further reduction, and the undersize via two 36-in. conveyors with magnets to a 15,000-ton steel bin. From here the indicated conveyor system transfers the ore to the main coarse-ore storage plant.

The secondary crushing plant contains four standard 7-ft. cone crushers set to give a minus 1-in. product. These receive the oversize from four steel grizzlies, with 2-in. spacing ahead of them, which are fed by four 36-in. conveyors with magnets operating between the coarse-ore storage bin and the grizzly floor. Grizzly undersize and the product from the cone crushers are transported by a conveyor system consisting of four 28-in. and two 60-in. conveyors, one with a tripper, to the elevated 750-ton steel bin in the fine-crushing plant. This bin serves 48 electric vibrating screens covered with Ton-Cap screens having 5/16x3/4-in. openings. Drum-type feeders withdraw the ore from the surge bin and deliver it to the screens. Undersize goes via a suitable conveyor system having a Weightometer direct to a 16,000-ton fine-ore storage bin, while the oversize is conveyed first to a 750-ton surge bin fitted with apron feeders, and then to six 7-ft. short-head

Flowsheet of New Cornelia's 20,000-Ton Concentrator

1. 20 and 30- cu. yd. side-dump cars
2. 48-in. gyratory crusher
3. Four steel grizzlies spaced 2 in.
4. Four No. 8 Gates gyratory crushers
5. Two 36-in. conveyors with magnets
6. 15,000-ton steel ore bin
7. Conveyor system consisting of four 24-in. conveyors with trippers, and three 48-in. conveyors
8. Two 7,400-ton steel ore bins
9. 600-ton concrete hopper
10. 8-ft. apron feeder
11. 54-in. McCully crusher
12. Conveyor system consisting of a 5-ft. apron feeder, one 48-in. conveyor, and three 42-in. conveyors, one with a magnet
13. Four 36-in. conveyors with magnets
14. Four steel grizzlies spaced 2 in.
15. Four 7-ft. standard cone crushers
16. Conveyor system consisting of four 28-in. conveyors, and two 60-in. conveyors, one with tripper
17. 750-ton steel bin for screen feed
18. 48 drum feeders
19. 48 vibrating screens
20. Conveyor system consisting of two 34-in. conveyors, one 48-in., and three 42-in. conveyors, one with weightometer
21. 16,000-ton steel ore bin
22. Two 54-in. conveyors
23. 750-ton steel bin for short-head cone feed
24. Six 26-in. conveyors
25. Six 7-ft. short-head cone crushers
26. Six 28-in. conveyors
27. Eight 24-in. conveyors with weightometers
28. Sixteen 6x15-ft. primary ball mills
29. Sixteen 78-in. single spiral classifiers
30. Sixteen 6x15-ft. secondary ball mills
31. Sixteen 78-in. single spiral classifiers
32. Two pulp distributors
33. Thirteen 62-ft. Hunt-Dunn type flotation machines
34. Sump
35. Two 6-in. sand pumps
36. 12-ft. Hunt-Dunn retreatment cell
37. Two 60-ft. thickeners
38. One 275-ft. and two 200-ft. slime traction thickeners
39. Four 8-in. sand pumps
40. Tailings dam
41. Two 5,000-g.p.m. reclaimed-water pumps
42. Four 14x14-ft. drum-type filters
43. 24-in. conveyor
44. 60-ton concentrate cars
45. Two 6-in. sand pumps
46. 38-ft. Hunt-Dunn type cell
47. 21-ft. Hunt-Dunn type cell
48. Two 60-ft. thickeners
49. Two 6-in. sand pumps
50. Three 13-ft. bowl classifiers
51. 8x12-ft. ball mill
52. Reservoir for reclaimed water
53. Five 5,000-g.p.m. return water pumps
54. Air lift



cone crushers operating in closed circuit with the vibrating screens. The circulating load is from 2 to 2½ times the tonnage finished.

Shortening of the crushing zone of the short-head cone crushers, which relieves excessive stresses in the crusher head without reducing initial crushing ability, is an alteration made recently that has materially improved crusher efficiency.

By operating the secondary and fine crushing plants on a two-shift basis (afternoon and night), necessary repairs can be carried out during the remaining 8-hr. period.

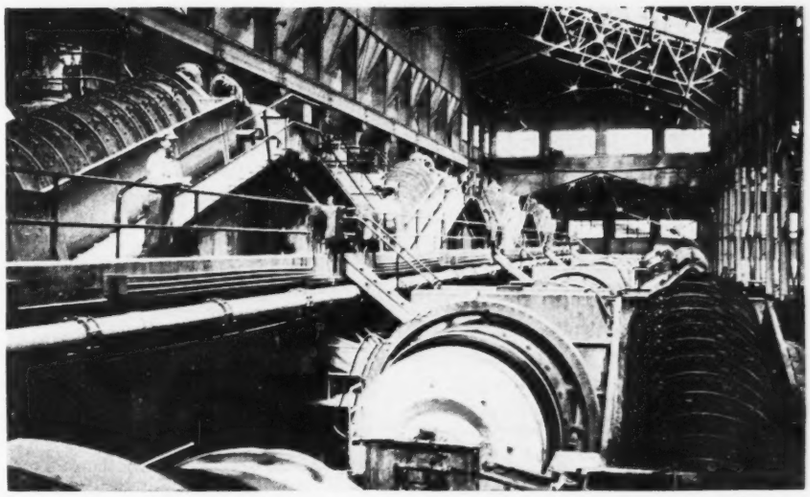
As to dust control, a 50,000-c.f.m., low-pressure wet dust recovery system is available in the secondary and fine crushing plants, and a 10,000-c.f.m. unit of similar design serves several conveyor junction points away from the main plant. Other dust-control measures include spraying, cleaning of conveyors, plant structures and machinery by means of a vacuum cleaning unit and nozzle developed locally, and the sealing of the screen feed bins and short-head crusher feed bins as described in the March, 1940, issue of *Engineering and Mining Journal* (p. 55).

Tonnage handled per hour by the two primary crushers, four standard cone crushers, and six short-head cone crushers is 1,500, 1,300, and 1,000 tons respectively. Power consumption is 2.76 kw.hr. per ton, and steel consumption 0.08 lb. per ton.

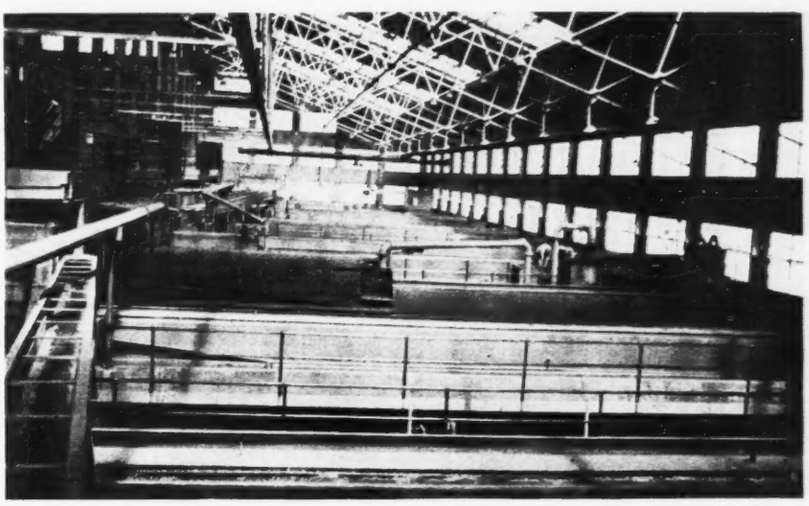
Ore is drawn off from the fine-ore bins by sixteen 42-in. conveyor feeders which discharge onto eight 24-in. conveyors with Weightometers and is reduced to flotation feed in two stages. For this work there are available 8 grinding sections, each consisting of two 6x15-ft. primary ball mills and two 6x15-ft. secondary ball mills operating in closed circuit with 78-in. single-spiral classifiers. The mills are driven by 300-hp. synchronous motors and operate at 23.1 r.p.m. Ball loads (3-in. balls in primary and 2½-in. balls in secondary mills) average some 28 tons. Table I shows to what extent grinding is carried on.

Classifier overflow goes to two pulp distributors, which direct it to thirteen 62-ft. rougher flotation cells. The tailings from these units flow by gravity to three traction thickeners, the underflow and overflow respectively being pumped to the tailings dump and mill tank. Rougher concentrates with a copper content ranging from 16 to 25 per cent are collected in a concrete sump, whence they are pumped to a 12-ft. retreatment cell producing from 50 to 75 per cent of the total tonnage of final concentrates. The regrind unit handling tailings from the retreatment cell consists of two 8x12-ft. ball mills driven by 300-hp. synchronous motors and operated at 15 r.p.m., and three 13-ft. bowl classifiers. Subsequent treatment of the classifier overflow involves two-stage cleaning, there being available for this operation a 38-ft. cell and a 28-ft. cell. Tailings from the larger unit are thickened in two 60-ft. thickeners before returning to the rougher circuit, while the concentrates are directed to the smaller unit by means of an air lift.

Concentrates representing production from the 21-ft. cleaner join those produced by the 12-ft. retreatment unit to be treated successively in two 60-ft. thickeners and four 14x14-ft. drum-type filters, with tailings returning to the head of the 38-ft. cleaner cell. Filter cake is loaded into 60-ton concentrate cars and shipped to the Douglas smelter. Water reclaimed from the tailings pond, thickeners, and filters is



Primary and secondary ball mills with their respective closed-circuit spiral classifiers in the New Cornelia concentrator



In the flotation section. The pulp is divided among 13 62-ft. rougher cells, the concentrates going to a 12-ft. retreatment cell

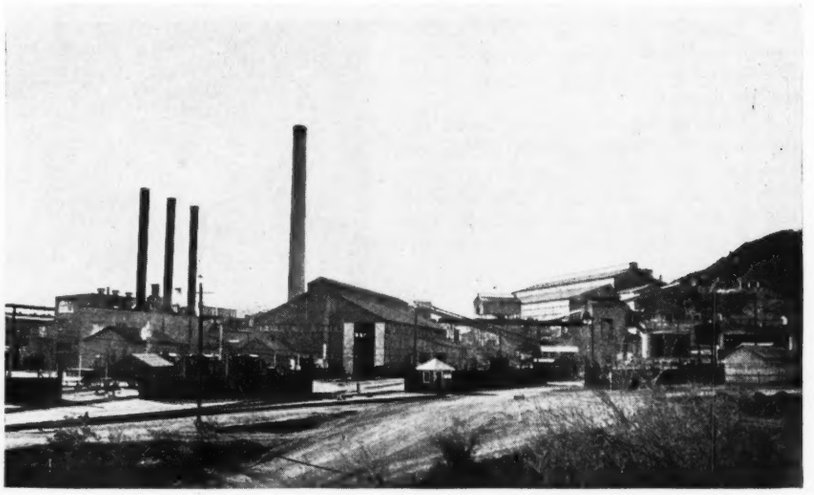
Table I.—Typical Analyses of Mill Feed and Grinding Products

Mesh	Mill Feed	Primary Mill Discharge	Primary Classifier Sand	Secondary Mill Discharge	Secondary Classifier Sand	Flotation Feed
+4	25.5	3.6	4.6	0.2	0.2	
6	16.6	2.6	3.3	0.2	0.3	
8	9.8	2.8	3.6	0.2	0.3	
10	11.4	6.2	7.9	0.6	0.8	
14	6.4	6.0	7.6	0.8	1.0	
20	4.6	6.8	8.7	1.8	2.3	
28	4.5	10.2	13.0	5.0	6.3	
35	3.3	11.6	14.8	10.4	13.1	
48	2.7	10.4	12.7	17.8	21.9	2.0
65	2.4	9.4	9.9	22.0	25.3	8.4
100	2.4	6.4	4.5	13.2	12.0	15.5
150	2.3	4.8	2.8	8.4	6.9	13.1
200	2.2	3.6	1.8	4.6	3.0	10.5
−200	5.9	15.6	4.8	14.8	6.6	50.5

pumped back to the mill storage tank.

General mill data are as follows: Ratio of concentration 37.14 to 1; total copper content in mill feed, 0.93 per cent, with 0.01 per cent being oxide copper; per cent solids in flotation feed, 23.1 (about 11.3 per cent is plus 65 mesh); per cent solids in tailings to dam, 41.5; moisture content of concentrates at smelter, 6.03 per cent; per cent copper in final concentrates, 31.29, insoluble, 13, and iron, 24.20; general tailing, 0.09 per cent total copper, 0.01 per cent oxide copper; extraction, 90.89 per cent total copper, 92.13 per cent sulphide copper; total power consumption per ton, 13.25 kw.-hr.; dry tons per man shift, 74.4; ball and liner consumption per ton, 1.940 and 0.157 lb.; and fresh water, 232 gal. per ton of ore.

Air for the flotation department is furnished by two 20,000-c.f.m. centrifugal blowers driven by 650-hp. synchronous motors; one 30,000-c.f.m. centrifugal blower powered by a 650-hp. motor, and two 8,000-c.f.m. cycloidal blowers with 200-hp. motors as standby units. The reagent practice is as follows: Lime in milk form is added to both grinding circuits, and reagent No. 244 and pine oil are fed to the primary classifier overflows. Respective consumption is 1.05, 0.025, and 0.167 lb. per ton of ore milled. Ore containing native copper and cuprite are treated with xanthates (collectors). Sampling is done both automatically as well as by hand, in general practice at 15-minute intervals.



New Cornelia's power plant and repair shops. In the right background is the concentrator. The company makes its own power in a steam plant

Water for plant operations is obtained from a large pumping plant about 6½ miles north of Ajo. Here are two concrete-lined, two-compartment shafts more than 700 ft. deep with a network of drifts penetrating the water formation. The pumping equipment operates against a 1,160-ft. difference of elevation and supplies water to 20-in. and 10-in. pipe lines at the surface.

Power for the mine reduction plants and town of Ajo is generated in a large steam power plant, with substations stepping down the voltage from 2,300 to 440 and 110 volts. Apart from the concentrator maintenance shops, there are near the power plant well-equipped machine, boiler, and electric shops.

▼ ▼ ▼

A Summary of the Potash Situation

THE present armed conflict in Europe, like that of 1914, disrupted a world monopoly (of potash), but the cartel that in recent years controlled 90 per cent of the world output was an international syndicate comprising French, Polish, and Spanish as well as German producers and having reported sales agreements covering production in the U.S.S.R. and Palestine, according to Bertrand L. Johnson, in Information Circular 7117 of the United States Bureau of Mines. The break-up of these commercial agreements has necessitated readjustments but generates no such alarm as the closing of a single source of supply. In striking contrast to the critical shortage that developed a quarter century ago, no increase in prices has occurred or is anticipated in the domestic market.

Before the World War Germany enjoyed a virtually complete monopoly of world trade in potash. The War destroyed this hold but also cut off the only source of potash into the United States. Prompted by this crisis the search for domestic potash, already begun because of restrictions by the recently nationalized German industry, was intensified.

The Versailles Treaty started competitive development in three countries of the then-known large potash deposits. It gave the Alsatian deposits to France and the Galician deposits to Poland. Prices were forced down so that in 1924 Germany and France agreed to partition the important American market and in 1925 extended their agreement to cover all foreign markets. This two-nation agreement was the beginning of the international cartel which took over the functions of the pre-war German monopoly.

Later, however, extensive potash deposits were discovered in several countries, notably Spain, the U.S.S.R., Palestine, and the United States. Franco-German control of the world potash markets was disturbed at intervals by the competition of the uncontrolled production of the new producing countries, but this interference was met by taking the disturbing countries into the cartel or by making marketing agreements with them. Because of legal restrictions, the United States was not in the cartel, but at the beginning of 1939 world potash producers, excepting this country, were in apparent agreement both as to price and marketing allotments.

The total production of potash in all countries rose from a little over a million tons (actual K_2O) in 1918 to about 2½ million tons in 1929; in Germany alone the output doubled. Notwithstanding the new sources of supply the world-wide depression cut sales in half, but after 1932 the total rose abruptly, reaching nearly 3½ million tons in 1938.

Six countries have recently furnished about 99 per cent of the world potash. In 1938 Germany still dominated the world markets, providing more than three times as much potash as France, the second largest producer, although Germany's share of the total had decreased to 62 per cent as against 95 per cent in 1918. Even before war was declared in September 1939, about 20 per cent of the world potash supply was coming from deposits developed largely since the World War, but the cartel controlled over 80, per cent of the total and virtually the entire output outside of the United States from deposits largely developed after the World War. Domestic producers had just begun to compete strenuously with importers in their home market and to venture into export trade in a small way.

PHOSPHATE

The Vital Non-Metallic

A travelogue of the Florida and Tennessee fields

A. H. Hubbell
Associate Editor

FOR YEARS the story of phosphate rock has in the main been one of mining and preparing a raw material for fertilizer manufacture, and so it is today. More recently, much work has been done in the direction of developing new fertilizers and intermediate materials having greater and greater content of available phosphorus, culminating in the large-scale production of elemental phosphorus itself, and the story—if one were to set it down with a thought to the future—could well be called the story of phosphorus.

To amplify the initial statement, more than four-fifths of the tonnage of phosphate rock that is mined still goes into the production of fertilizers, and most of this into the ordinary familiar superphosphate, made by treating the washed and perhaps partly floated rock with sulphuric acid, to yield a product containing 16 to 20 per cent P_2O_5. The interest in more concentrated fertilizers arises because this superphosphate appears to be a dilute product in respect to its phosphorus content, and rather a bulky one for shipping, perhaps long distances, to the ultimate consumer, who primarily wants the phosphorus[1]. The transformation of the rock into the superphosphate, moreover, is often effected at points some hundreds of miles from the mining areas. Florida rock is shipped for the purpose as far north as Carteret, N. J., Boston, and Buffalo. Thus one can readily appreciate that freight rates play an important part in the cost of the product, both before and after the insoluble rock has been converted into the soluble fertilizer, and that they materially increase the price that the farmer has to pay, as compared with the value of the raw rock at the mines—approximately $2.89 per ton on the average for all grades of Florida pebble rock in 1939.

It has been to meet this situation, at least in part, that efforts have been directed by both private industry and the Tennessee Valley Authority in its experimental work at Muscle Shoals, to producing more concentrated fertilizers, such as the so-called triple superphosphate, which contains about 45 to 46 per cent available P_2O_5, or two to three times as much as the ordinary superphosphate, and is made by using phosphoric acid instead of sulphuric acid in treating the raw rock, according to the formula, $Ca_3(PO_4)_2 + 4H_3PO_4 + 3H_2O = 3[CaH_4(PO_4)_2\ H_2O]$. In 1938, the tonnage of domestic triple superphosphate consumed was approximately 180,952 tons*, compared with a domestic production of 4,111,000 short tons of ordinary superphosphate. Besides the TVA plant at Muscle Shoals, there were eight private plants in the United

[1] A good part of ordinary superphosphate is gypsum—calcium sulphate produced in the conversion, and it may be said that the farmer wants this also but perhaps could get it for less separately.

* Bureau of Plant Ind., Washington, D. C.

At Mulberry. An aerial view showing the main drying and storage plant of International Agricultural Corporation and, in the foreground, the company office, the guest house, and some of the dwellings

States listed as making it. Only two of these are in Florida, that of the United States Phosphoric Products Company, at Tampa, and the plant of Phosphate Mining Co., at Nichols.

The underlying idea in seeking the greater concentrations is that the fertilizer manufacturer, in some cases, can produce the more concentrated material at a plant cost higher than that of making the ordinary superphosphate and yet deliver it to the farmer at a lower figure. It has been formulated thus[2]: "If the factory cost of P_2O_5 in the more concentrated superphosphate can be reduced to the cost of P_2O_5 in the ordinary superphosphate, the more concentrated product can be delivered to the farm the cheaper, owing to saving in handling, in bags, and in freight." The effort has been characterized as trying to squeeze the freight out of the phosphate rock on its way to the consumer.[3]

Still other products of a concentration higher than the ordinary superphosphate that have been the subject of investigation include so-called fused rock, calcium or potassium metaphosphate, tetraphosphoric acid, and phosphorus, this being their order in respect to the degree of concentration and not the historical order of development. Metaphosphate a material produced in the electric furnace by a process developed by TVA in the last few years and containing 60 to 66 per cent of allegedly available P_2O_5, is being carefully studied as to its effects when applied directly to the soil. (Mechanical means for applying these more concentrated fertilizers in smaller quantities evenly to the ground are said to be available.) Tetraphosphoric acid contains 84 per cent P_2O_5 and requires only the addition of water to convert it into phosphoric acid.

Consideration of fused rock, a promising material not yet fully tested, brings to light an interesting fact. Raw phosphate rock is called insoluble in that plant life cannot normally assimilate its phosphate content. That this content is really in the form of calcium fluophosphate instead of tricalcium phosphate, as long assumed; that most rock contains 3 to 4 per cent of fluorine and that it is the presence of this element that makes the rock insoluble escaped attention for many years—at once surprising and humiliating. By fusing the rock at approximately 1,600 deg. C. in the presence of water vapor, it is found that the fluorine is driven off and the phosphate is rendered soluble. Fused rock contains about 33 per cent available P_2O_5 and is thus of a higher concentration than the ordinary superphosphate. But its value to agriculture has not yet been ascertained.

Capping all achievements, in point of degree of concentration, has been the highly successful large-scale production in the electric furnace, from a charge of phosphate rock, silica, and coke, of elemental phosphorus, according to the reaction $Ca_3(PO_4)_2 + 3SiO_2 + 5C = 3CaSiO_3 + 5CO + 2P$. Phosphorus so made has become an important commodity of commerce, moving in tank cars to consuming points. Here we have the product of maximum concentration made by smelting a raw material that can be of about the lowest grade of rock that is classified as phosphate matrix or ore.[4]

In this last development we see that phosphate rock has taken on a new aspect as the ore of phosphorus. It will not be strange if the availability of elemental phosphorus in large quantities should eventually bring about marked changes in phosphate fertilizer manufacture and use.

If, as has been said, this nation has rapidly been becoming conscious of the vital rôle of phosphorus in permanent agriculture, much has been done to make it so. Manufacturers of fertilizers have long pursued a course of instructing the farmer in matters concerning soil fertility. With the initiation of the Tennessee Valley project by the Federal Government in 1933, or soon afterwards, and the Authority's decision to engage in the production of phosphate fertilizers for experimental purposes at Muscle Shoals, partly because of the large resources of phosphate rock near by, the efforts to educate the farmer were multiplied. Enthusiasm of the New Deal propagandists, however, gave birth to alarmist teachings, partly true and partly exaggerated, that the phosphorus content of the country's soil was being rapidly lowered through crop removal plus erosion and runoff; that it must be restored and maintained through more generous application of phosphates; that the country's phosphate rock reserves were limited and were being depleted seriously through exports to foreign countries and that such loss was quite irreparable.

As a result of this agitation, the President, in May, 1938, in a special message to Congress, declared that the soil of the United States "faces a continuing loss of productive capacity" and recommended that a joint committee of the Senate and the House be named to study and report on the subject of the phosphate resources of the country. Congress took action on June 16, a committee of six began its hearings at Washington two days later, and thereafter continued them at Pocatello, Idaho, Sheffield, Ala., and Knoxville, Tenn., bringing them to a close at Lakeland, Fla., on Nov. 29 of that year.

United States Phosphate Statistics, 1938–1939*

	1938 Long Tons	1938 Average Value at Mines	1939 Long Tons	1939 Average Value at Mines
Mined production				
Florida	2,722,927		2,791,360	
Tennessee	999,551		1,057,570	
Western States	137,998		139,040	
Total	3,860,476		3,987,910	
Sold or used by producers				
Florida				
Land pebble	2,528,808	$3.16	2,547,782	$2.89
Soft rock	53,479	3.33	41,906	3.06
Hard rock	125,048	4.81	89,096	4.62
Total, Florida	2,707,335	3.24	2,678,784	2.95
Tennessee	899,298	4.14	938,448	4.11
Western States	132,505		139,835	
Total	3,739,138	3.46	3,757,067	3.27
Exports	1,140,841	5.82	949,006	5.51

* Excerpted and rearranged from chapter in Bureau of Mines Minerals Yearbook, by B. L. Johnson, and K. G. Warner.

Phosphate Rock Sold or Used by United States Producers By Grades*

Grades—B.P.L. content[a] (per cent):	1938 % of Total	1939 % of Total
Below 60	12	11
60 to 66		1
68 basis, 66 minimum	10	9
70 minimum	10	10
72 minimum	24	33
75 basis, 74 minimum		
75 minimum	25	20
77 basis, 76 minimum		
77 minimum	9	9
Above 85 (apatite)		
Undistributed	10	7

* Excerpted from Minerals Yearbook, 1940.
[a] See footnote 6 on opposite page.

[2] Dr. H. A. Curtis, formerly of the Tennessee Valley Authority, made the statement that is quoted in testifying before the Joint Congressional Committee. Fertilizer manufacturers, however, feel that the general statement erroneously conveys the idea that the production of 16 to 20 per cent superphosphate is, in every case, an uneconomical and wasteful procedure.

[3] Paul M. Tyler, testimony before Joint Committee.

[4] E. G. Klug, testimony before Joint Committee.

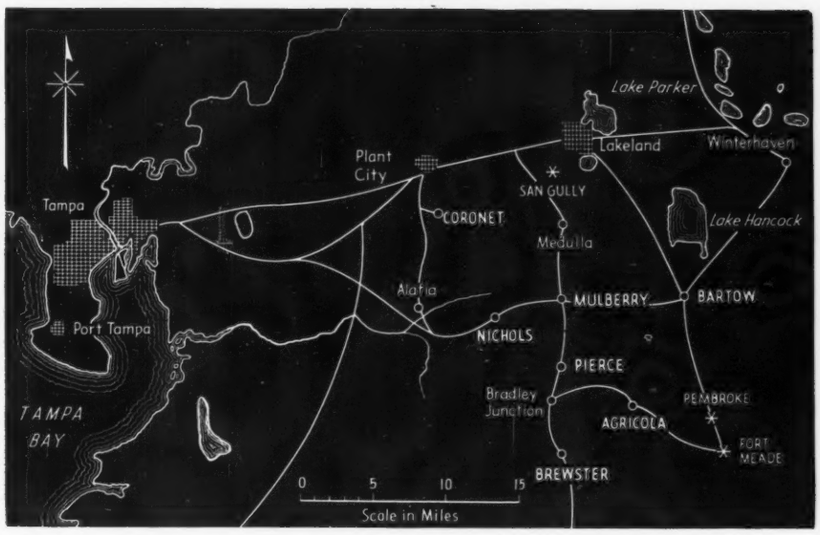


Fig. 1 . . . Sketch map of Florida pebble field, showing the local headquarters of the seven active companies

The crux of the inquiry was the question whether the exportation of phosphate rock should be prohibited to conserve this valuable resource. Normally this country has exported about one-quarter to one-third of its total output of phosphate, this including all of the hard rock and part of the pebble rock.[5] The answer reached after examining witnesses in all sections of the industry, including representatives of agriculture, was a very definite "No." Re-appraisal of reserves, in the light of improved technology, particularly with respect to the application of flotation to recovering phosphate formerly lost in washing, and in the use of the electric furnace for smelting phosphatic material once considered worthless, showed the country to possess huge resources of recoverable phosphate, or if one wishes, phosphorus. The result was reassuring, inasmuch as it has been shown that a stoppage of exports, aside from causing some unemployment, would result in raising the price of the phosphate rock that was sold at home, the export sales having been more lucrative. The testimony taken at the hearings before the Joint Committee will long remain a valuable source of information regarding the different phases, technologic and economic, of phosphate and fertilizer production and consumption.

Further delving into the details of phosphate fertilizers and of their manufacture and ultimate consumption is not our purpose here. What has been said thus far is intended to serve as background for a picture of current operations at the mines and washing plants in the active phosphate districts of Florida and Tennessee as recently observed.

In these two States are three of the four phosphate-producing and reserve areas of the country. The four are: The land-pebble field and the hard-rock field of Florida, the Tennessee field, and the Western field. The first is by far the most important today. Of the total production of phosphate rock in the United States in recent normal years 75 per cent came from Florida and 20 per cent from Tennessee. The bulk of the Florida production is from the pebble field.

The Florida Fields

The pebble field of Florida lies east of Tampa, the best-known portion centering at Mulberry, 40 miles or more from the Gulf Coast and including such operating headquarters, in addition to Mulberry, as Pierce, Brewster, Nichols, Bartow, Agricola, and Coronet. Near by on the north is the winter resort and business town of Lakeland and to the east the resort of Winter Haven. Development of the land pebble deposits began in 1890. They occur principally in western Polk and eastern Hillsborough counties and extend into Manatee and Hardee counties. According to the State Geologist, Dr. Herman Gunter, testifying before the Joint Congressional Committee, this type of phosphate is made up of "rounded and subangular phosphate pebbles, varying in color from white through gray to brown and black and in coarseness from fine grains to large pebbles, embedded in a matrix of sand, clay, soft phosphate, fine pebbles, and rock fragments."

Florida's hard-rock deposits, first discovered near Dunellon in 1888, occur in a long belt of variable width and of pockety character stretching from near Dade City north about 100 miles and roughly parallel to the Gulf Coast, but inland 20 to 30 miles. The hard-rock phosphate, according to Dr. Gunter, occurs as large boulders, nodules, fragments, and pebbles embedded in a phosphatic, clayey, and sandy matrix, with a sand-clay overburden ranging up to 30 ft. or more in depth. The deposits are extremely irregular in size and may vary in depth from a few feet up to as much as 70 ft. The percentage recoverable varies, but the average grade of rock is high, ranging from 76 to 80 per cent B.P.L. (see footnote 6 below) some boulders running higher.

Associated with both of these varieties of phosphate is so-called soft phosphate, which was once lost in mining and washing but is now being recovered in increasing quantities from old waste ponds.

In 1938, when both the pebble and the hard-rock fields of Florida were active, there were ten producers in the State, with some 2,225 employees and a total output of approximately 3,000,000 long tons of phosphate. The pebble field, which is by far the more important of the two, had seven of the ten producers, 2,000 of the 2,225 employees, and approximately 95 per cent of the production. Today the seven companies of the pebble field are still active, with approximately the same number of employees, though with a somewhat smaller output, thanks to curtailment of exports due to war conditions. Their combined invested capital is put at $33,000,000.

The hard-rock industry, on the other hand, with a capital investment of $2,000,000[7] including port facilities at Fernandina, north of Jacksonville, is shut down completely in consequence of the war in Europe, its entire production having customarily been sent abroad. Its inability to compete for domestic business was ascribed by a witness[8] at the Congressional inquiry as due to being too close to the cheaply mined pebble fields which supply the southern and eastern markets and too far from the fertilizer-consuming area of the Central States, supplied from the Tennessee field. The producers that have normally found it possible to exist owe it to the fact that the hard-rock phosphate is the highest-grade material mined in the United States—highest in P_2O_5 and lowest in iron and alumina (referred to colloquially in the industry as I & A).

The seven active producers of the Florida pebble field, the order not necessarily indicating their relative rank in point of output, are tabulated on the following page:

[5] One Florida company, the Pembroke Chemical Company, has been sintering matrix for export, until recently at least.

[6] B.P.L., bone phosphate of lime, is the same as tricalcium phosphate, $Ca_3(PO_4)_2$. Phosphate rock in the industry is usually spoken of in terms of B.P.L. Thus rock containing 70 per cent B.P.L. is known as 70 per cent rock. The equivalents for conversion may be taken as follows: 1 lb. of P_2O_5 equals 2.185 lb. of B.P.L. equals 0.44 lb. of phosphorus.

[7] E. F. Fitch, testimony before the Joint Committee.

[8] Wayne Thomas, testimony before Joint Committee.

International Agricultural Corporation, with local headquarters at Mulberry, Fla.

American Agricultural Chemical Company, Pierce, Fla.

American Cyanamid Company, Brewster, Fla.

Southern Phosphate Corporation, Bartow, Fla.

Phosphate Mining Company, Nichols, Fla.

Swift & Company Fertilizer Works (subsidiary of Swift & Company) at Agricola

Coronet Phosphate Company, at Coronet

All seven were visited on the trip to be described.

As divulged in the course of the testimony before the Joint Committee, the holdings of these companies total only 163,881 acres,[9] a small fraction of the phosphate-bearing land in pebble field. Most of the phosphate land in Florida is still in the possession of the farmer. The companies' reserves have been conservatively put at a nominal 500,000,000 tons, their own estimate excluding much tonnage that might well have been included in the light of the accomplishments of flotation and electric-furnace smelting.

In this regard, it is interesting to note that G. R. Mansfield, of the United States Geological Survey, had pointed out[10], two or three years earlier, that whereas in Florida attention was directed to material containing 70 per cent or more of B.P.L. (equivalent to 32 per cent P_2O_5) and less than 3 per cent of iron and alumina, material as low as 40 per cent B.P.L. could be treated by the electric furnace and other methods, and he subsequently amended this (in 1938) saying that one operator was already working material containing only 15 per cent B.P.L. The abundance of the lower-grade materials had been indicated by the results obtained by the Survey[11] upon testing a phosphate-bearing area in the pebble field. Almost all of it was shown to contain at least 40 per cent B.P.L., more than four-fifths contained 50 per cent or better, and approximately half of it 60 per cent.

A rectangle approximately 30 miles square will include the active portion of the Florida pebble field. The seven operating companies have their headquarters respectively at the communities of Mulberry, Pierce, Brewster, Bartow, Agricola, Nichols and Coronet, shown in the sketch map in Fig. 1. The various mines and washing plants, however, are scattered over the entire area, frequently at distances of 10 miles or so from their head offices, and a visitor, such as I last May, must do much traveling to and fro if he would obtain even superficially a picture of the operations. This visitor, arriving by rail and expecting to hire the necessary conveyance, rarely was able to furnish it himself, thanks to the kindness of the executives and staff members of the companies visited, who anticipated such needs. This is only one of the pleasant recollections of an exceedingly interesting, if crowded, field trip.

So much has already appeared in print regarding the mining and washing operations in the pebble field that it would be presumptuous to attempt a detailed account of the technical work in progress. The reader who thirsts for comprehensiveness will find an excellent description of the average practice of the field in the paper presented before the A.I.M.E.[12] in 1936 by Chester A. Fulton, of Baltimore, president of the Southern Phosphate Corporation. Likewise the processing of the rock, with some exceptions, has been well covered in the *Transactions* of the Institute. What follows will be rather the jottings from a field note book with such observations as may seem pertinent.

Large-scale operation with a high degree of mechanization using superior up-to-date equipment is the order of the day at these land-pebble operations. Nature has helped to make this possible, in spreading her layers of phosphate-bearing material, or matrix, sometimes as much as 25 ft. thick, beneath an overburden blanket of varying depth, over extensive, though irregular, areas. The ratio of overburden to matrix, in conjunction with the latter's grade, is a determinant of minability. American Cyanamid, at Brewster, claims the greatest depth of overburden stripped, some 40 ft., but more about this hereafter.

The current mode of working, involving dragline stripping and hydraulic mining of the uncovered matrix in almost all cases, has been a good many years in reaching its present stage. These deposits were first worked in 1890, a day of hand methods, mule scrapers, and dinky locomotives. Hydraulic stripping made its appearance early in the present century, permitting deeper mining but eventually yielding to steam shovels, which, after undergoing a certain increase in size, in turn gave way gradually to the dragline. This excavator made its Florida debut in or around 1921[13] and by the middle thirties had supplanted hydraulicking save for mining matrix, obviating the loss of matrix caused by cutting the ditches in it for hydraulic stripping. Change is constant, however, and experimentation the vogue, with the cost sheet in control. At at least one mine today,

Hydraulic mining of phosphate matrix in the Florida pebble field is demonstrated in a general way in this view of operations in one of International Agricultural Corporation's pits. Hydraulic giants (1) under 220-lb. pressure are attacking matrix bed (2), which has been stripped by dragline at right. The matrix is sluiced into ditches (3) running to sump at (4), from which it is picked up by suction (5) of pit-car pump and pumped through matrix line (6) to washer. Various modifications of this procedure are seen. The matrix bed may be much thicker. Overburden likewise varies in depth

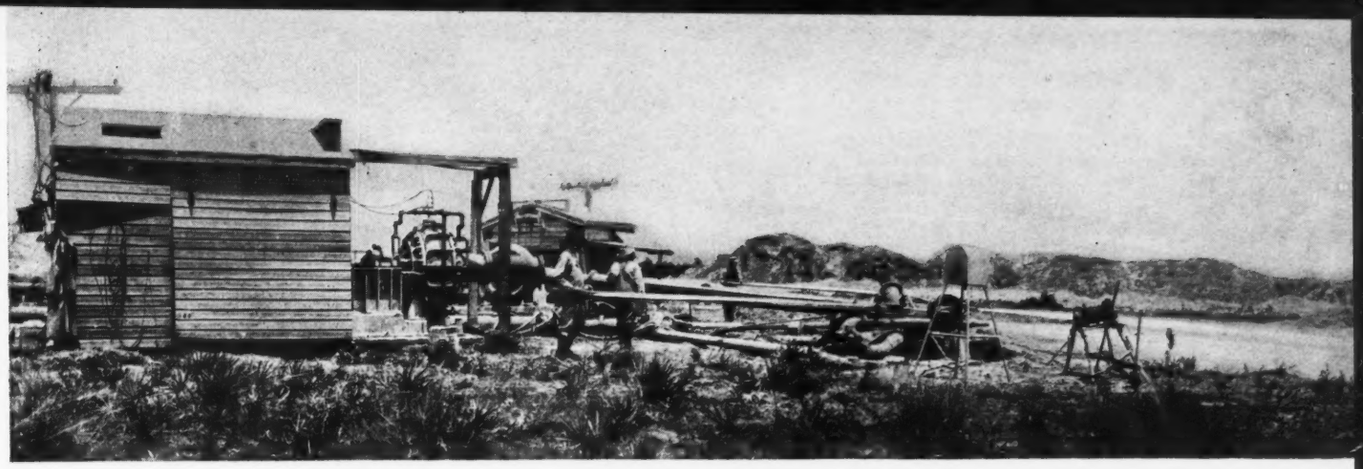
[9] In addition there is approximately 55,000 acres held by eleven inactive companies.

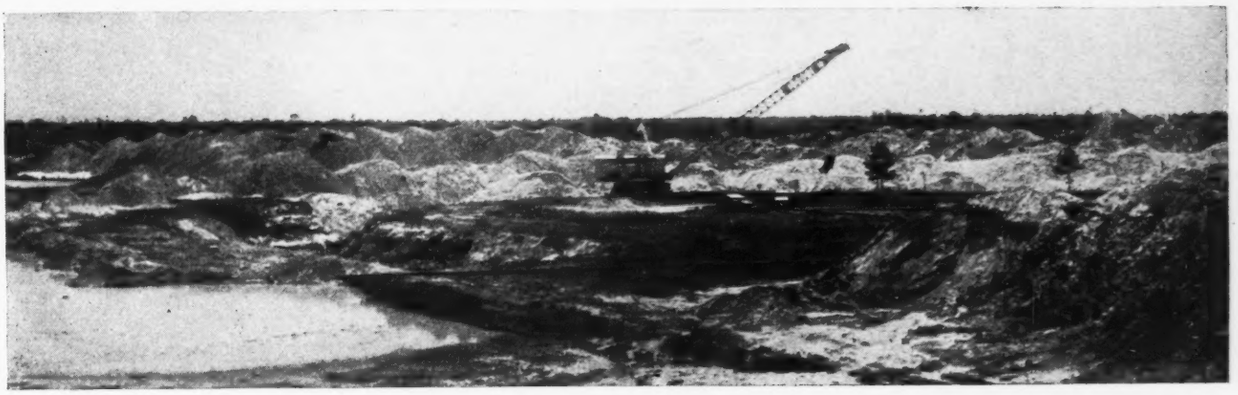
[10] Press release, U. S. Geological Survey.

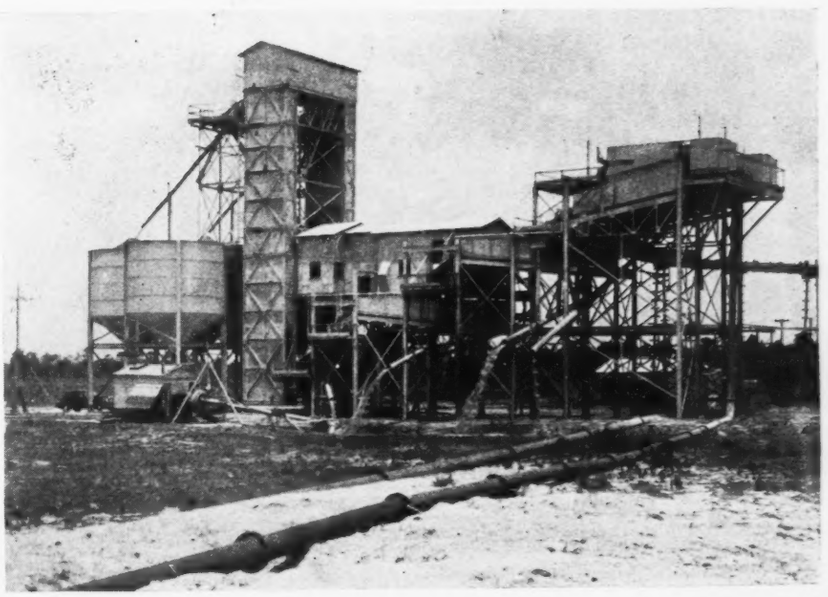
[11] Florida still has public lands, under control of the Federal Government. Of them 66,796 acres are in phosphate reserves, withdrawn from entry in 1919. In 1934 and 1935 to ascertain whether the Government was justified in retaining the mineral rights to certain tracts, the U. S. Geological Survey examined 3,300 acres of withdrawn pebble lands and 240 acres in the hard-rock field to determine their phosphate content. As yet there are no Government leases in Florida. The rest of the phosphate lands in the State are privately owned.

[12] Technical Publication 662, A.I.M.E., 1936.

[13] "Phosphate Rock Mining, 1880–1937," U. S. Bureau of Mines, p. 14.







At I. A. C.'s No. 122 mine and washing plant. At the mine the experimental departure from customary mining practice described in the text is under way. The picture immediately above shows a distant view of the dragline at work on the remnant of unmined ground and, in front of it, the hydraulic giants and pit car on the surface. A close-up of this hydraulicking operation is shown in the cut at the top of the page. The ma'r'x dug by the dragline is dumped on the surface, where it is sluiced by the three giants into the sump in the center, from which the pit-car pump picks it up and sends it to the washing plant. At the right, No. 122 washing plant, about 1,200 ft. from the pit

where the phosphate is unusually soft, the dragline has already ousted the monitor for mining matrix also, and elsewhere intermediate methods are being tried.

Hydraulic mining and the subsequent pumping of the matrix to the washer, usually within a mile, help to loosen the accompanying clay, thereby easing the task of washing. The combined operations of mining and transporting require considerable water. To provide the necessary supply is a first consideration on opening a property. This is usually done by putting down a deep well to supplement the amount available on the surface, and thereafter the water is carefully conserved by a system of reservoirs and ditches.

Water, plus overburden, plus matrix add up to give the total tonnage of material the pebble operators have to handle. Expressed in relation to merchantable output the figure is large. Mr. Fulton has calculated it to be 22½ tons of material handled for every ton of washed rock produced. And yet 70 per cent washed rock has sold at the Florida dryer for $2.75 per ton. The average operator likes to point this out, when some one mentions that the farmer pays $14 to $20 per ton for his 18 per cent superphosphate.

The number of employees at these extensive operations is impressively small. Approximately 2,000 is the total for the seven enterprises, reflecting once more the extent of mechanization and the application of electric power.

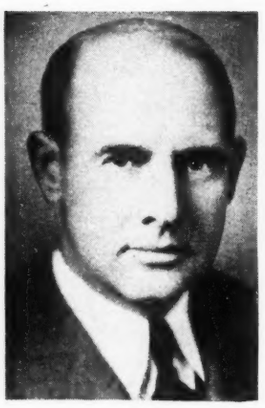
Having previously received the kind permission of Louis Ware, president of the International Agricultural Corporation, who had arranged the necessary preliminaries, I proceeded to Mulberry early on the day I arrived at Lakeland, which is an excellent place to stop for one visiting the field. Here I was cordially received by R. B. Fuller, general manager of the company, which is called the I.A.C. for short, and soon set forth to see something of the company's mines and plants under the guidance of James A. Barr, the company's chief engineer, who happened to be in Florida. Within Mr. Barr's bailiwick also are the operations of the Union Potash & Chemical Corporation, at Carlsbad, N. M., a subsidiary of the I.A.C., and he divides his time between Florida, Tennessee, and New Mexico as well as the New York office.

The I.A.C. is generally acknowledged

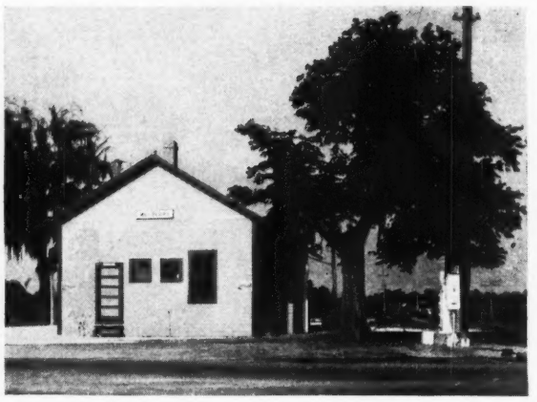
to be somewhat the largest producer of phosphate rock in the industry. It employs 300 men in Florida and has a total of some 40,000 acres acquired by purchase from private owners. In the pebble field it is mining matrix at two primary mines, Nos. 92 and 122 respectively, using the dragline for stripping and hydraulic sluicing, and is working an old dump—now half consumed—at Pembroke by suction dredge.

The method pursued, in general, in the district in mining a tract of ground involves, as one of the preliminaries, the location of the washer in such a position that it can serve the entire tract, if possible, without being moved and without excessively long distances for pumping matrix. This commonly results in placing it at the center of the tract and working the four quarters successively with dragline and hydraulic giants. The limiting distance of the washer from the matrix pump (or pit car) in the pit is usually a mile, with a booster pump every 1,500 ft. To begin excavation in the average typical case the dragline will start at the outside corner of a quarter diagonally furthest from the washer and strip a cut some 200 ft. wide, more or less, retreating down the outside edge of the quarter toward the center line of the tract on which the washer is positioned. The spoil is piled on the company's adjacent ground. As the dragline thus retreats, the monitors follow it up at varying distances, often within 200 or 300 ft., attacking the uncovered matrix at a face originally created for them by the dragline. The pit car pump, in the pit or on the bank, follows up the monitors at intervals to keep the amount and depth of ditching to a minimum. The width of such a cut depends on the length of the dragline boom and varies from 135 to 160 ft. When the first cut is stripped, the dragline starts one next to it, beginning at the far end and piling the stripping in the first cut made, which by this time has been mined out. In this way the work proceeds, but almost every mine will exhibit some variation from this average method, especially where an irregular-shaped small fraction must be mined.

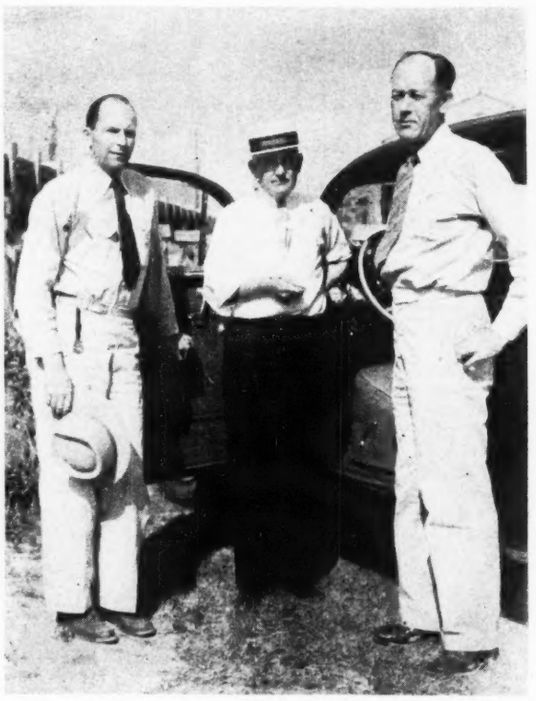
Thus at I.A.C.'s No. 122 mine, 440 acres were being worked divided into four equal tracts, with the washer at the center of the four, two of which had been mined out in the manner approximately as described, save for a small piece of one of them where three months before an experimental variation had been started. Here the excavator was a Marion full-revolving electric dragline of the caterpillar type, having a 150-ft. boom and a partly welded 8½-cu.yd. Page bucket with manganese-steel teeth, which are built up as needed. The overburden was approximately 30 ft. in depth and the matrix 10 ft. Beneath the latter was 10 to 15 ft. of clay and below that, I was told,



Louis Ware, president of International Agricultural Corporation, New York



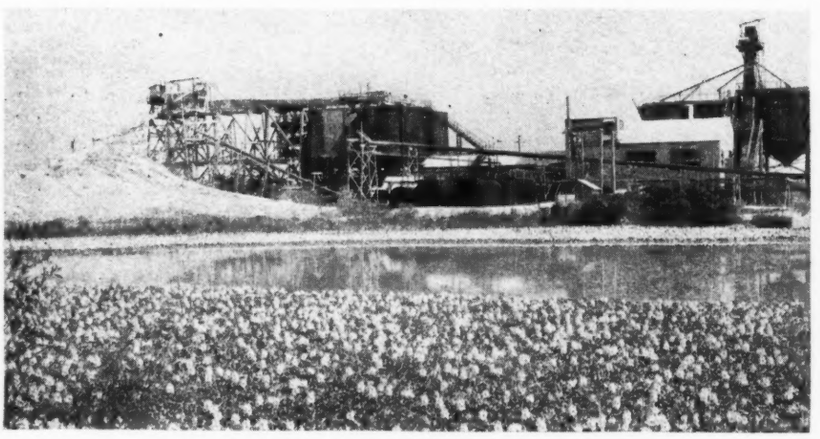
The old mulberry tree, from which Mulberry, the Florida headquarters of the I. A. C., takes its name, still stands beside the railroad



James A. Barr, chief engineer of the I. A. C., in the center. Right, Arthur Crago, general manager of Phosphate Recovery Corporation, Mulberry, Fla. Left, J. N. Norton, of I. A. C.'s New York office

John T. Burrows, vice-president of International Agricultural Corporation, New York

R. B. Fuller, general manager of International Agricultural Corporation, Mulberry, Fla.



Phosphate Recovery Corporation's No. 4 flotation plant at Pembroke. The pond is bordered with Florida's ubiquitous water hyacinth

the Hawthorn formation, the low-grade phosphatic content of which is responsible for part of the great boost recently given to Florida's reserves of phosphate. In this pit occasionally domes of soft dolomite, which are left unworked, bulge up into the matrix.

Hydraulic guns, or giants, made by the Georgia Iron Works, were in service here. They were of the single-jointed type, swinging 360 deg. horizontally and with a vertical range of 30 to 40 deg. Usually three are used in a pit, two for attacking the face of matrix and one for sweeping the pit behind the others. The hydraulic pressure for mining purposes may range up to 225 lb. per square inch, which was about the maximum anywhere observed. Here the monitors, instead of working in the pit in the standard manner, were on the bank, as were the pit car (as the pumping unit consisting of the matrix pump and the shed alongside of it containing the motor and control is known) and the hydraulic and matrix pump lines. The dragline was digging matrix, after having stripped it, and was piling it on the bank at the pit edge where the monitors, at close range, were sluicing it at 125-lb. pressure into the 8-ft. deep sump, that had been dug near by on the bank by the dragline with one side sloping toward the heap and widened to 15 or 20 ft. to let the matrix run in. Nozzles varying from 1¾ in. to 3 in. in diameter were employed.

At the clear-water pumping station serving this operation there were two pumps, one capable of a 225-lb. head and the other of 80 lb. Pressure thus could be controlled by changing pumps or by throttling at the pump. Most of the clear-water pumps noted in the district were of Allis-Chalmers or Worthington make. The matrix pumps in use are largely made by the Georgia Iron Works, though an occasional Hydroseal was seen. The clear-water line coming from the pumping station was 20 in. in diameter, branching into 14-in. lines on entering the pit at the so-called 3-way, from which 6 to 8-in. lines, spiral-welded, run to the guns.

Here the matrix pump was a 12-in. Georgia unit having a 14-in. suction line with a swinging-jointed section running into the sump and a 14-in. discharge line running to the washer. It was driven by a 300-hp. 600-r.p.m. induction G.E. motor. The matrix was pumped at 25 per cent solids to the washer 800 ft. away at the rate of 400 tons of solid feed per hour.

Mine and washer were running three 8-hr. shifts per day, the pit being flood-lighted with 500-watt bulbs at night. The dragline had a crew of two, operator and oiler, plus a ground man, making three in all. Two men constituted the washer crew per shift.

No. 122 washer is of the double type, each of the two units taking 200 tons of feed per hour. Of this the plus 1¼-in. material and the minus 1-mm. material are sent to waste. There is no flotation plant here, because there is not enough value in the minus 1-mm. waste to make it commercially feasible.

An approximate flowsheet of one unit of the No. 122 washer is given in Fig. 2. Sometimes in series ahead of the washer a whole-current classifier is used to remove the 14-mesh or the 1-mm. material. This was not being done at the time of my visit, because the percentage of solids in the feed had recently been increased to 25 (as stated) from 10 to 15, and the use of the classifier would have risked sticking the line, one of the hazards of hydraulic transportation that calls for constant watchfulness.

No. 92 mine and the treatment plants that serve it were not visited. The mining operations there are conducted on the usual pattern. The washing is followed by flotation.

Instead, we next journeyed to Pembroke, where Phosphate Recovery Corporation, a subsidiary of the I.A.C., is mining a dump with a suction dredge. This dump resulted from an earlier washing operation conducted when screening was done at 14 mesh, the undersize being rejected. Retreatment today has been possible because this is one of the relatively scarce instances where earlier operators stacked their washing plant waste separately from the spoil derived from stripping, the overburden having been hauled away.

Originally, the Pembroke dump contained about 1,000,000 tons of recoverable phosphate. Mining has been under way for the last five years and in three more it is estimated the dump will have disappeared.

The suction dredge is equipped with a Georgia Iron Works pump, handling 3,000 g.p.m., which delivers 200 cu.yd. of bank per hour at 20 per cent solids. The dredge is run long enough to keep the plant operating 24 hr. per day. The distance between the dredge and the plant is approximately 1,500 ft., with a booster pump midway. By means of a spillway and an intermediate pool for storage near the plant, the level of the dredge pond can be regulated. Separate systems are provided for mine water and flotation-plant water, all of which returns by gravity.

The 12-in. line of the dredge delivers to a trommel at the flotation plant having a ¼-in. hole. The flowsheet is shown in Fig. 3. Oversize is small in amount and is wasted. Each feed bin overflows the slime at the side, the sand settling and being fed (one bin at a time) to two 4x10-ft. rod mills, one Marcy, one Allis-Chalmers). Rod-mill discharge goes via two 3-in. Wilfley pumps to a 20-ft. bowl classifier having 8-ft. rakes. The entire tonnage (aside from original slime overflow) is put through the mills for the purpose of scrubbing as well as grinding. The company would like to grind to 35 mesh, but usually there is approximately 15 per cent that is plus 35. In any future installation, it was said, there would be no rod mills, but in their place Fahrenwald sizers and the plus 35 mesh would be agglomerated.

The bowl classifier in the flowsheet serves to deslime and dewater. Fuel oil, fatty acid, and caustic soda are added to the rake product, which goes to a rotary mixer (having lifters), the discharge being split between two bucket elevators which deliver it to flotation.

A subsidiary of the I.A.C., namely the Phosphate Recovery Corporation, operates the company's flotation plants, controlling the patents under which the work is done and supervising the licensing of them to other operators. I.A.C. pioneered and financed the development of the flotation process for the recovery of phosphate from washer waste. In working out this process to a successful commercial operation, it has more than doubled the reserves of the pebble district. Through its subsidiary, Phosphate Recovery Corporation, it owns and controls the patents for floating phosphate rock as well as many other non-metallic minerals. The other operators, through licenses granted, are given the benefits of the experience already gained. Phosphate Recovery Corporation maintains a well equipped research laboratory at Mulberry. Here, it is continuously conducting research to improve the present process on phosphate and develop new methods for recovering other non-metallic minerals by flotation. Arthur Crago is manager of the Phosphate Recovery Corporation and he was good enough to give me the flowsheet of the Pembroke plant, Fig. 3, revised by him as of May 8 last.

The plants operated by Phosphate Recovery Corporation are numbered in the order of erection. No. 1, now torn down, stood at I.A.C.'s No. 11 washer. No. 2 was built on an old dump but is now treating waste from the No. 92 washer, near Mulberry. No. 3 is at Wales, Tenn. No. 4, at Pembroke, we have just described. No. 5 is at Mount Pleasant, Tenn.

Drying Plant

To the I.A.C. drying plant at Mulberry is delivered wet rock (pebble) from the company's washers; likewise all flotation concentrate. These materials arrive in trains of 50-ton cars via the company's electric railroad. The wet rock is dumped from a trestle, from where it is reclaimed as needed by a 36-in. belt conveyor running in a tunnel underneath. Storage room is increased by use of a clamshell excavator, which takes the wet material from the trestle dump and builds a parallel pile to one side. Flotation concentrates are dumped into bins, from which they

are similarly reclaimed by another 36-in. conveyor. These come mostly from No. 2 flotation plant at 92 mine, 3 miles from Mulberry, and partly from No. 4 flotation plant at Pembroke via the Atlantic Coast Line Railroad, which shares the servicing of the pebble district with the Seaboard Air Line. Each 36-in. belt discharges at the rate of 400 tons per hour to a 30-in. cross belt delivering to an elevator which in turn raises the material to the top of a 400-ton feed silo, there being two such elevators, each with its silo. At the top there is provision for transferring the material discharged from each conveyor to either silo.

Each silo serves its own 6x60-ft. oil-fired (direct-heat) parallel-current rotary dryer, burning Bunker C fuel oil. Furnace temperature ranges from 2,600 to 2,800 deg. F. The feed is dried to 2 per cent moisture. A large excess of air is used. Gases plus dust are pulled from the dryers by two American blowers respectively on the roof of the building. One is a 30,000-c.f.m. unit and the other of 20,000 c.f.m. capacity. Both do the same work, the smaller blower being somewhat more efficient.

The dried product on leaving the dryer is weighed on a Richardson Scale Company weighing machine and is then elevated to the dry storage bins having a total capacity of 30,000 tons and occupying a building several hundred feet long. Such storage bins make this and the dryers of other operators conspicuous landmarks in the district. The dried material is distributed by two horizontal belts and trippers.

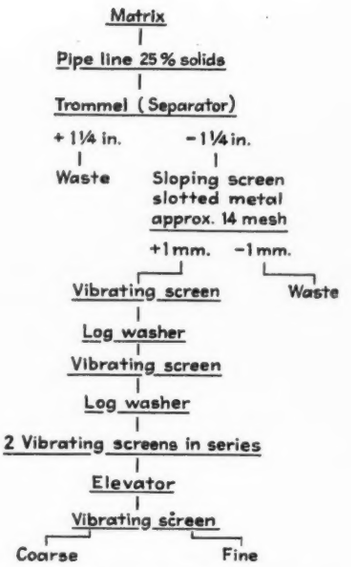


Fig. 2 . . . Approximate flowsheet of one unit of I. A. C.'s No. 122 washing plant

An adjunct of the drying plant is the grinding plant, which now serves to grind to specifications for certain customers. It is equipped with four Type 7 Kent ring-roll mills (Kent Mill Company, Brooklyn) and four Sturtevant air separators. The mills are driven by 2,080-volt G.E. induction motors, running at 600 r.p.m. through multiple V-belt drives. The V-belts are of Gates make, furnished by Mine & Mill Supply Company, of Lakeland. If the drying plant were run at its full capacity it could handle almost 1,000,000 tons per year, according to Mr. Barr.

The I.A.C., like other operators in the pebble field, is giving thought to the condition in which the surface of the land is left after mining is completed. The procedure of stripping and mining in successive parallel cuts converts what was originally a fairly level terrain, grassed over and perhaps timbered, into a series of alternate windrows and furrows. The height of the former varies up to 40 ft., according to the depth of matrix removed and the volume of overburden redeposited. Though such ground may be considered hopeless for normal agriculture, it is not so for grass and timber, at least in many cases. Under the plans of rehabilitation[14], part of this area will remain in permanent, if artificial, lakes, and part is being planted with trees.

So far as it is concerned, the I.A.C. is engaged in some reforestation, and approximately 200 acres, in plots of various size, is being utilized to demonstrate what can be done by replanting with pine and other trees.

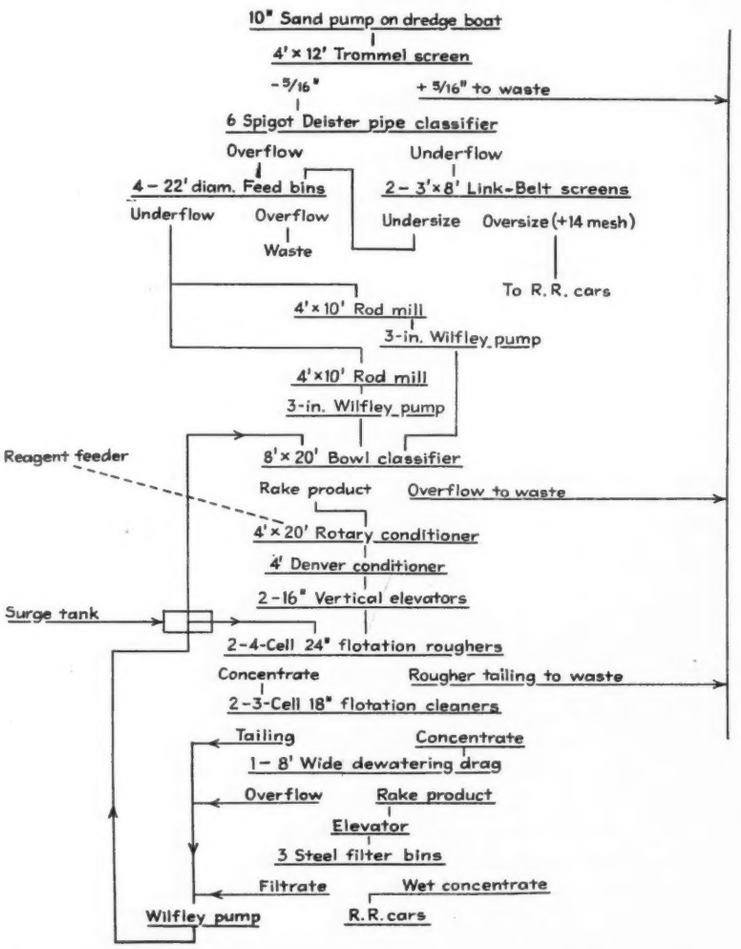


Fig. 3 . . . Present flowsheet of No. 4 flotation plant of Phosphate Recovery Corporation, subsidiary of I. A. C.

Power

In the earlier days, a phosphate company usually generated its own power for operation. This custom gradually changed as purchased power became available in larger quantities, and today practically all the operators are customers of the local utility companies. Their own plants usually are maintained in good condition, if only to serve as standbys in a pinch. The I.A.C., similarly protected by an efficient plant, buys its power today from the Tampa Electric Company, which brings it into Mulberry at 66,000 volts, delivering it to the company at half this voltage. The company then steps it down to successively smaller voltages according as needed. Most of its motors installed take in the neighborhood of 2,200 volts.

(To be continued)

[14] Testimony of Wayne Thomas at Joint Hearing.

No. 1 dredge unit of Lincoln Gold Dredging Company on Klamath River, California, comprising washing plant and dragline with 2-cu.yd. bucket

Some Operating Costs of Dredging on the Klamath River

Almost 500,000 cu. yd. handled by dragline and floating washer at less than 13 cents per cubic yard

V. Austin

Chief Accountant
Lincoln Gold Dredging Company
Lincoln, Calif.

IN VIEW OF THE FACT that there has been considerable discussion but very little information concerning the cost of operating so-called "doodlebug" dredges, consisting of a floating washing plant supplied by a dragline or other excavator, I am presenting here the cost sheet of the Lincoln Gold Dredging Company, covering its operations on the Klamath River, near Happy Camp, Calif., from March 15 to Sept. 3, 1939.

Lincoln Gold Dredging Company is a partnership, having been organized as such in January, 1939, the partners being E. M. Clark and W. K. Jansen, both of Lincoln, Calif. At the time of writing they are operating one dredge on the Trinity River and one on Clear Creek, near French Gulch, Calif.

Both of these units before this had been in operation on the Klamath River. No. 1 boat has a daily capacity of 4,000 cu.yd. and No. 2 3,000 cu.yd. The two draglines are respectively a Northwest, having a 2-cu.yd. bucket, and a P. & H. unit, with a 1¼-cu.yd. bucket. Average depth of ground on the Klamath River was approximately 20 ft., of which 8 to 10 ft. was overburden. Stripping was done at the outset by both draglines, three tractors and two 8-cu.yd. scrapers. However, two tractors and the scrapers were returned after it was found that this method of stripping was impractical for the property, this explaining the item "Loss on Equipment Returned" in the tabulation under "Tractor Units." No. 2 boat was thereupon tied up and stripping was done by the dragline formerly used with it. Thus it was that No. 1 Unit washing plant operated 163 days, whereas No. 2 washing plant ran only about two weeks.

The Lincoln company desired a cost system after its organization and, as chief accountant, I installed one, the results of which are given here. I owe much to Frank E. Warren, dredgemaster on No. 1 boat, for the accuracy of labor and material distribution. The figures given show only the cost of moving dirt and include nothing for royalties or exploration.

Recapitulation

No. 1. Dredge Unit	$27,719.85	$0.05702
No. 2 Dredge Unit	10,549.37	0.0216
Tractor Units	14,903.67	0.03065
General	9,494.70	0.0195
Total	$62,667.59	$0.12877

Dredge Operating Costs on Klamath River

March 15 to Sept. 3, 1939. 485,910 Cu. Yd. Handled

Operating Groups	Operating Cost	Cost Per Cu. Yd.
No. 1. Dredge Unit		
Dragline payroll	$4,552.16	$0.00937
Dragline fuel and oiling	3,947.53	0.00812
Dragline maintenance	5,201.04	0.0107
Dredge payroll	4,426.04	0.00911
Dredge fuel and oiling	2,753.32	0.00567
Dredge maintenance	1,778.62	0.00366
Depreciation	3,861.77	0.00794
Industrial insurance	674.18	0.00138
State unemployment tax	354.50	0.00072
Federal unemployment tax	39.39	0.00008
Federal old age benefit	131.30	0.00027
Total	$27,719.85	$0.05702
No. 2. Dredge Unit		
Dragline payroll	$2,508.81	$0.00516
Dragline fuel and oiling	1,673.64	0.00344
Dragline maintenance	2,439.91	0.00502
Dredge payroll	734.88	0.00151
Dredge fuel and oiling	598.48	0.00123
Dredge maintenance	792.03	0.00163
Depreciation	1,418.38	0.00293
Industrial insurance	214.03	0.00044
State unemployment tax	114.22	0.00024
Federal unemployment tax	12.69	.....
Federal old age benefit	42.30	0.00011
Total	$10,549.37	$0.0216

Operating Groups	Operating Cost	Cost Per Cu. Yd.
Tractor Units		
Payroll	$1,754.98	$0.00361
Fuel	627.81	0.00129
Dredge maintenance	1,778.62	0.00366
Maintenance	3,209.94	0.0066
Depreciation	547.30	0.00112
Industrial insurance	97.91	0.0002
State unemployment tax	52.55	0.00016
Federal unemployment tax	5.84	.....
Federal old age benefit	19.46	.....
Loss on equipment returned	8,587.88	0.01767
	$14,903.67	$0.03065
General		
Administration	$1,415.02	$0.00291
Insurance	628.89	0.00129
Telephone and telegraph	75.00	0.00015
Auto and truck expense	887.03	0.00182
Depreciation	462.91	0.00095
State unemployment tax	234.62	0.00048
Federal unemployment tax	26.09	.....
Federal old age benefit	86.90	0.00023
Siskiyou county taxes	867.20	0.00178
Miscellaneous expenses	3,292.45	0.00677
Interest and express	818.58	0.00168
Employee's bonus	700.00	0.00144
	$9,494.70	$0.0195

USEFUL OPERATING IDEAS

Sifting Mechanically Through Standard Testing Sieves

F. A. W. Davis
Assistant Mining Engineer

D. A. Deaderick
Junior Ceramic Engineer

Tennesee Valley Authority, Norris, Tenn.

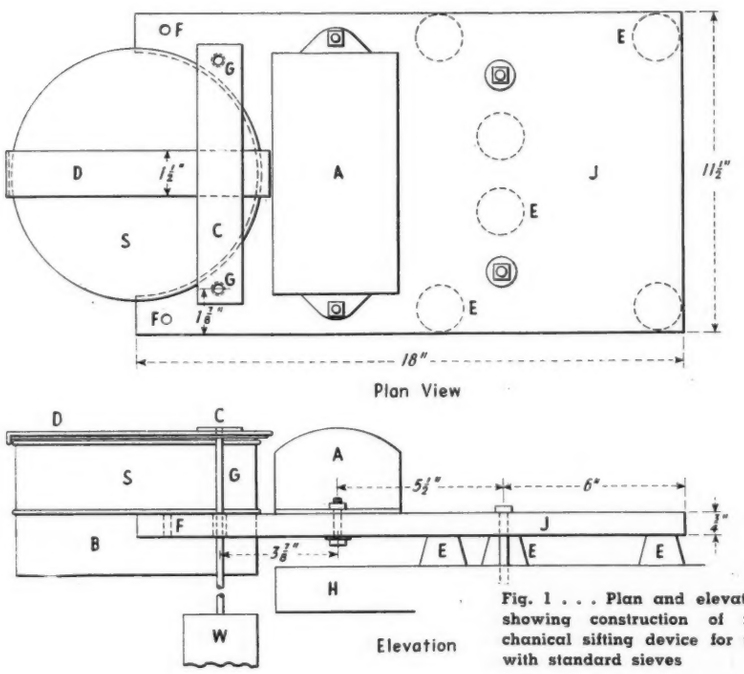


Fig. 1 . . . Plan and elevation showing construction of mechanical sifting device for use with standard sieves

NEED HAS BEEN FELT by the authors for a flexible, portable, low-cost device for mechanically sifting both dry and wet materials through standard testing sieves for laboratory and plant technical control use. The apparatus described was worked out jointly by the authors and is being used at the Minerals Testing Laboratory of the Tennessee Valley Authority, and the Electrochemical Laboratory of the United States Bureau of Mines.

The method best suited to the purpose was that of electromagnetic pulsations. The Model V-9 Syntron electric vibrator equipped with an electric controller, made by the Syntron Company, Homer City, Pa., was found to be satisfactory. Various applications of this piece of equipment were made with the final apparatus as shown in the illustrations.

In Fig. 1, *A* is an electromagnetic pulsator, *B* the testing sieve pan, and *C* and *D* constitute the counterweight frame. *E, E, E* are No. 10 rubber stoppers. At *F* are holes for 5/32-in. diameter, good-quality laboratory rubber tubing, having a wall 1/16 in. thick. *G, G* are brass rods, ¼ in. in diameter. *H* is the table or bench top. The vibrating board should preferably be of hard wood and in one piece. At *S* are the standard 8-in. high or low testing sieves. Counterweight cylinders made of brass tubing filled with steel shot are shown at *W*.

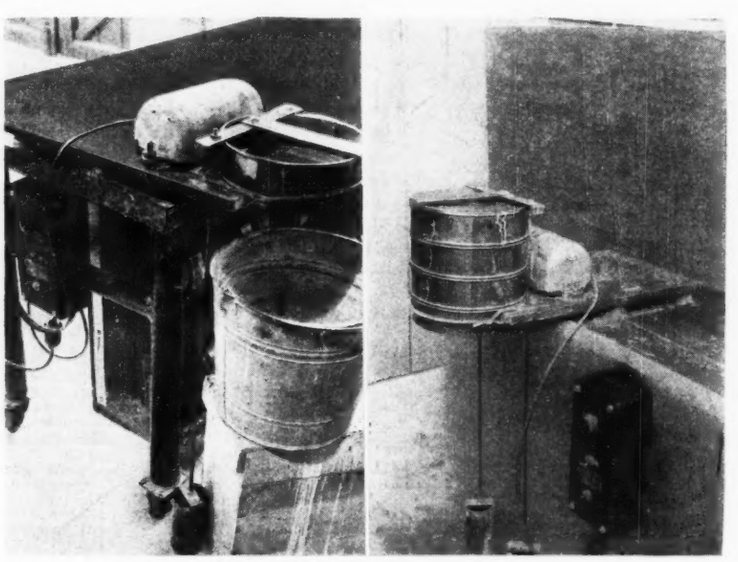
For ordinary table heights, the apparatus has a capacity of ten high sieves and the pan. The counterweights and the frame which presses the sieves tight together and against the vibrating board weigh 10 lb. Proper use of the electric controller to vary the intensity and rate of the pulsations greatly improves the efficiency of the sifting.

The apparatus was developed in 1936. Two laboratory machines were built and have been in operation over three years with no maintenance required other than replacing the laboratory rubber tubing used to hold the pan or sieve securely in the curved slot of the vibrating board. No excessive wear or breakage of the wire cloth or soldered joints between wire cloth and sieve frame has occurred.

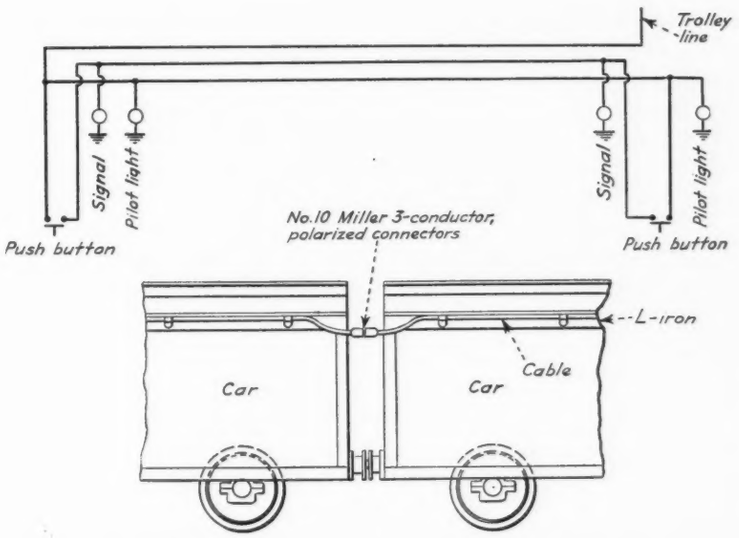
▼

A Signal System

AN INTERESTING electrical development at the Emma Nevada mine of Consolidated Coppermines Corporation, Kimberly, Nev., that has contributed materially to safer underground ore haulage is the train signal system shown in detail in the accompanying sketch. Ore trains in the mine consist of a 13-ton trolley locomotive and from 16 to 20 cars,



Left, Apparatus arranged for wet sifting. Right, For dry sifting



Illustrating the train signal system used in the Emma Nevada mine to permit signaling between motorman and brakeman on long ore trains underground

each 10 ft. long, and all haulage of materials is done in the single-track drift served by the vertical Emma Nevada shaft. As loaded trains and returning empty trains must travel over the same track, a carefully planned train schedule and an adequate dispatch and signal system are indispensable if the required daily tonnage of ore is to be moved with utmost speed and safety.

One difficulty encountered was to provide a dependable signal system for the ore trains, which, when composed of 20 cars, attain a length of more than 200 ft. Not only is a whistle almost inaudible at this distance, but it is impossible to signal an emergency stop to the motorman when the train is rounding a curve. This difficulty has been satisfactorily overcome by the simple signal system evolved by the electrical department. As will be seen, it enables the motorman and the brakeman to signal to each other, the push-button operated at either end of the train flashing on the red signal lights. The pilot lights are installed to show when the circuit is complete, and that there is power. The power cable running along the entire length of the train consists of short sections held by clamps to the L-iron on the side of each car, and united by Miller No. 10, three-conductor, polarized connectors. Current is taken from the trolley line.

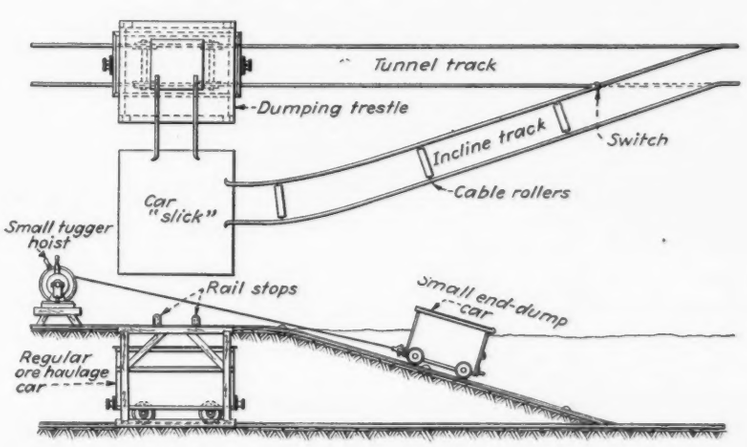
▼ ▼ ▼

Ore Transfer Layout

WHILE new ground was being explored at the property of Nevada - Massachusetts Company, about 8 miles northwest of Mill City, Nev., a problem arose recently as to transporting ore from it to the 250-ton concentrator, according to Ott F. Heizer, general manager. Here, transportation from the different loading points on the surface is done by a 7-ton Plymouth locomotive, generally hauling a six-car, 30-ton train over a 24-in. gage track. At the new development, however, the conventional transportation methods could not be used, as the cross-section of the drift was too small for the standard 5-ton cars. In consequence, all ore broken in the face and stopes had to be handled in small end-dump cars, and transferred to the large cars outside the portal. To do this by hand would be tedious, slow, and costly. The difficulty was successfully overcome by the handy ore transfer layout, see sketch.

Use is made of a wooden dump trestle covered with a steel plate containing a square dump hole, an inclined track, steel car "slick," and a short section of track connecting the top of the dump trestle with the car "slick." The small end-dump cars are hauled and lowered over the incline track by means of an air-operated tugger hoist.

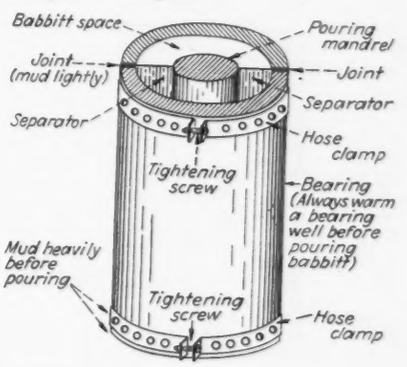
Operation is simple and rapid: Each loaded car on the tunnel track is first hauled on to the car "slick" by the tugger, then turned and pushed by hand to the top of the trestle, and subsequently dumped through the square opening into the 5-ton car spotted under the trestle.



▼

For Alignment When Babbitting

THE HALVES of an oil-ring-type bearing must be held in perfect alignment for babbitting. They must also grip tightly the sheet metal or cardboard strips used for separators, to permit separation of the halves after the babbitt is poured. After trying many methods, Evan W. Baker, of 129 East Gregson Ave., Salt Lake City, says he finally hit upon the idea of using regular light metal clamps such as automobile-radiator hose clamps. After placing the pouring mandrel, separators, and bearing halves in place, he says the entire assembly should be clamped with a clamp of proper size on each end of the bearing. It should be tightened firmly with a screwdriver and mudded, lightly along the seams but heavily to the bearing and surface upon which it stands. The babbitt may then be poured without fear of having to do the job over again.



MONTHLY COMMENT • DAILY AND AVERAGE MONTHLY

Summary of the

MARKETS

THE MOVEMENT of major non-ferrous metals into consumption has made further gains. Combined deliveries of copper, lead, zinc, and tin during August probably were larger than those of any other month so far this year. A strong factor in promoting activity here was the urgent demand for metals and fabricated products for export to the British Empire. Despite the larger deliveries, prices developed some irregularity. Sentiment in the market was influenced by the news from Europe, and nervousness about the situation abroad made it impossible to form an opinion on the long-term trend.

The *E. & M. J.* price index for August was 76.71, against 76.72 in July. Monthly averages were slightly higher on domestic copper and zinc, whereas lead, tin, and aluminum declined. Nickel and silver prices showed no change.

Domestic sales of copper for August totaled 67,281 tons, against 58,577 tons in July and 110,453 tons in June. The large mine operators revised their selling basis to 11c., Valley, on Aug. 7, a reduction of one-half cent. The competitive market moved up to that level later in the month, so that all sellers once again were on an even basis. Domestic consumption for July was estimated at 78,000 tons, with August at 80.000 tons.

Lead buying did not come up to expectations and the quotation was lowered to 4.75c., New York. At that level business improved and the price advanced to 4.90c. However, the closing quotation was 10 points below the figure named at the beginning of August. Domestic consumption of lead has increased to about 50.000 tons a month.

A high rate of operations in brass and galvanized products has absorbed the output of domestic zinc smelters, even though foreign concentrate has been moving into this country in fair volume. Prime Western zinc advanced to 6¼c., St. Louis.

Arrivals of tin were large and prices eased moderately. Aluminum was reduced 1c., effective Aug. 1.

UNITED STATES MARKET

	Electrolytic Copper		Straits Tin	Lead		Zinc
1940	Domestic	Export	New York	New York	St. Louis	St. Louis
Aug.	(*a*) Refinery	(*b*) Refinery				
1	11.025	9.825	52.625	5.00	4.85	6.25
2	10.775 @ 11.025	9.850	52.125	5.00	4.85	6.25
3	10.775 @ 11.025	9.850	52.000	5.00	4.85	6.25
5	10.775 @ 11.025	9.850	52.250	5.00	4.85	6.25
6	10.650 @ 10.775	9.850	52.250	4.85	4.70	6.25
7	10.525	9.850	52.125	4.85	4.70	6.25
8	10.525	9.850	51.875	4.85	4.70	6.25
9	10.525	9.850	51.750	4.75	4.60	6.25
10	10.525	9.850	51.750	4.75	4.60	6.25
12	10.525	9.825	51.750	4.75	4.60	6.25
13	10.525	9.850	51.000	4.75	4.60	6.25
14	10.525	9.875	50.750	4.75	4.60	6.25
15	10.525	9.850	50.750	4.75	4.60	6.50
16	10.650	9.850	50.750	4.75	4.60	6.50
17	10.650	9.850	50.750	4.75	4.60	6.50
19	10.650	9.850	50.750	4.75	4.60	6.50
20	10.775	9.850	50.625	4.75	4.60	6.50
21	10.775	9.875	50.625	4.90	4.75	6.50
22	10.775	9.875	50.625	4.90	4.75	6.50
23	10.775	9.850	50.625	4.90	4.75	6.50
24	10.775	9.850	50.625	4.90	4.75	6.50
26	10.775	9.850	50.625	4.90	4.75	6.50
27	10.775	9.850	50.625	4.90	4.75	6.50
28	10.775	9.850	50.625	4.90	4.75	6.50
29	10.775	9.850	50.500	4.90	4.75	6.50
30	10.775	9.850	50.500	4.90	4.75	6.50
31	10.775	9.850	50.500	4.90	4.75	6.50
			AVERAGES FOR MONTH			
Aug.	10.708	9.851	51.176	4.854	4.704	6.389
Aug.			**AVERAGES FOR WEEK**			
7	10.827	9.846	52.229	4.950	4.800	6.250
14	10.525	9.850	51.479	4.767	4.617	6.250
21	10.671	9.854	50.708	4.775	4.625	6.500
28	10.775	9.854	50.625	4.900	4.750	6.500
Aug.			**CALENDAR WEEK AVERAGES**			
3	10.867	9.846	52.354	5.000	4.850	6.250
10	10.619	9.850	52.000	4.842	4.692	6.250
17	10.567	9.850	50.958	4.750	4.600	6.375
24	10.754	9.858	50.646	4.850	4.700	6.500
31	10.775	9.850	50.563	4.900	4.750	6.500

SILVER, GOLD AND STERLING EXCHANGE

	Sterling Exchange		Silver		Gold	
1940		"90-day	(*c*)			(*d*) United
Aug.	"Checks"	demand"	New York	London	London	States
1	386.000	(*f*)	34.750	22.3125	168s	$35.00
2	386.000	(*f*)	34.750	22.3125	168s	35.00
3	387.000	(*f*)	(*e*)	(*e*)	(*e*)	35.00
5	386.000	(*f*)	34.750	22.5000	168s	35.00
6	390.000	(*f*)	34.750	23.0000	168s	35.00
7	393.000	(*f*)	34.750	23.5000	168s	35.00
8	390.000	(*f*)	34.750	23.5000	168s	35.00
9	392.000	(*f*)	34.750	23.5000	168s	35.00
10	396.000	(*f*)	(*e*)	(*e*)	(*e*)	35.00
12	396.000	(*f*)	34.750	23.5000	168s	35.00
13	397.500	(*f*)	34.750	23.5000	168s	35.00
14	400.500	(*f*)	34.750	23.4375	168s	35.00
15	401.000	(*f*)	34.750	23.5000	168s	35.00
16	402.000	(*f*)	34.750	23.5000	168s	35.00
17	399.500	(*f*)	(*e*)	(*e*)	(*e*)	35.00
19	400.000	(*f*)	34.750	23.4375	168s	35.00
20	401.000	(*f*)	34.750	23.4375	168s	35.00
21	401.000	(*f*)	34.750	23.3125	168s	35.00
22	400.000	(*f*)	34.750	23.2500	168s	35.00
23	401.000	(*f*)	34.750	23.3125	168s	35.00
24	401.000	(*f*)	(*e*)	(*e*)	(*e*)	35.00
26	402.000	(*f*)	34.750	23.3125	168s	35.00
27	401.000	(*f*)	34.750	23.4375	168s	35.00
28	402.000	(*f*)	34.750	23.3750	168s	35.00
29	402.000	(*f*)	34.750	23.4375	168s	35.00
30	401.000	(*f*)	34.750	23.3750	168s	35.00
31	401.500	(*f*)	(*e*)	(*e*)	(*e*)	35.00
			AVERAGES FOR MONTH			
Aug.	396.889	.....	34.750	23.261	.....	35.00
Aug.			**AVERAGES FOR WEEK**			
7	388.000	.....	34.750	.....	.....	.....
14	395.333	.....	34.750	.....	.....	.....
21	400.750	.....	34.750	.....	.....	.....
28	401.167	.....	34.750	.....	.....	.....

Calendar week averages, New York Silver: Aug. 3rd, 34.750; 10th, 34.750; 17th, 34.750; 24th, 34.750; 31st, 34.750.

(*e*) Not quoted (Saturday). (*f*) No quotation.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(*a*) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(*b*) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Owing to the European War and the disruption of normal trade relations, our export copper quotations, since September, 1939, have been based largely on f.a.s. transactions, ex United States ports. To arrive at the f.o.b. refinery quotation deduct .05 from the f.a.s. basis for lighterage.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars: cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c per pound over the current market for Prime Western but not less than 1c over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(*c*) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c per troy ounce. Handy & Harman's quotation on newly-mined domestic silver, 999 fine was 70⅝c throughout August.

(*d*) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1940 August	Copper Standard Spot	Copper Standard 3 months	Copper Electro Bid	Tin Standard Spot	Tin Standard 3 months	Lead Spot Buyers	Lead Spot Sellers	Lead 3 months Buyers	Lead 3 months Sellers	Zinc Spot Buyers	Zinc Spot Sellers	Zinc 3 months Buyers	Zinc 3 months Sellers
1	Not quoted			267.7500	267.5000	Not quoted							
2	"	"	"	265.0000	265.2500	"	"						
5	"	"	"	265.7500	266.0000	"	"						
6	"	"	"	266.5000	266.5000	"	"						
7	"	"	"	266.5000	266.2500	"	"						
8	"	"	"	265.7500	265.7500	"	"						
9	"	"	"	265.0000	265.2500	"	"						
12	"	"	"	264.0000	264.5000	"	"						
13	"	"	"	263.0000	263.7500	"	"						
14	"	"	"	263.0000	263.7500	"	"						
15	"	"	"	263.0000	263.5000	"	"						
16	"	"	"	263.0000	263.7500	"	"						
19	"	"	"	262.0000	262.5000	"	"						
20	"	"	"	261.5000	262.0000	"	"						
21	"	"	"	261.0000	261.7500	"	"						
22	"	"	"	260.0000	260.7500	"	"						
23	"	"	"	260.2500	261.0000	"	"						
26	"	"	"	260.0000	260.5000	"	"						
27	"	"	"	258.2500	258.7500	"	"						
28	"	"	"	257.2500	258.0000	"	"						
29	"	"	"	258.0000	258.5000	"	"						
30	"	"	"	257.5000	258.5000	"	"						
Average for month				262.455									

Prices for tin are the official prices of the London Metal Exchange, in long tons (2240 lb.). Trading in other metals remained suspended.

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(Sept. 3, 1940)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	18c.
Antimony, domestic, spot, lb	14.00c.
Bismuth, ton lots, lb	$1.25
Cadmium, commercial sticks, lb	80c.
Calcium, lb., ton lots 97 @ 98 per cent	Nominal
Chromium, 97 per cent grade, lb	89c.
Cobalt, 97 to 99 per cent, per lb	$1.50
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	27c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$38.00
Quicksilver, flask of 76 lb., 100 flasks or more	$183.00
Radium, mg. radium content	$25.00@$30.00
Selenium, 99.5 per cent, lb	$1.75
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75
Thallium, 100 lb. or more, lb	$6.50
Titanium, 96 to 98 per cent, lb	$5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 48 @ 50% Cr_2O_3 c.i.f. Atl. ports, long ton	(b)$32.00@$35.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$4.75
Mesabi bessemer	$4.60
Old Range non-bessemer	$4.60
Mesabi, non-bessemer	$4.45
Lead (Galena) 80 per cent, Joplin, Mo., ton	$55.90
Manganese Ore, (foreign) c.i.f. U.S. ports, long ton unit of Mn:	
52 @ 55 per cent	(b) 57c.
50 @ 52 per cent	(b) 57c.
46 @ 48 per cent	(b) 50@52c.
Molybdenum Ore, 90%, per lb. of MoS_2, f.o.b. mines	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 65 per cent, duty paid	$23.50
Domestic, 65 per cent and upward	(a)$21.00@$23.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$42.50

(a) Prices at mines, small lots, usually several dollars less. (b) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3¼c.
Cobalt Oxide, 70 @ 71 per cent, lb	$1.84
Copper Sulphate, 100 lb	$4.60
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.42
Sodium Sulphate, bulk ton	$13.00@$15.00

ALLOYS

Beryllium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb	11c.
Ferromanganese, 78 @ 82 per cent, gross ton	$120.00
Ferromolybdenum, 55 @ 65 per cent Mo. lb. of Mo. contained	95c.
Ferrosilicon, 50 per cent, gross ton	$74.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$1.90@$2.00

NON-METALLIC MINERALS

Asbestos, f.o.b. mines (U.S. funds), ton:	
Canadian (Quebec)	
Crude No. 1	$700@$750
Crude No. 2	$150@$350
Spinning fibers	$110@$200
Paper stock	$40@$45
Shorts	$13@$17.50
Vermont	
Shingle stock	$57
Paper stock	$40
Cement stock	$25
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$6.50
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$7.00@$8.00
Domestic, abrasive, 80 @ 84 per cent	$14.00
Dalmatian, 50 @ 55 per cent	Nominal
French, 56 @ 59 per cent	Nominal
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$14.50
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$21.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00
Dead-burned, f.o.b. Washington	$22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in.	45@60c.
2 x 2 in.	60@80c.
3 x 3 in.	$1.25@$1.50
3 x 4 in.	$1.50@$1.75
3 x 5 in.	$1.75@$2.25
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12c.
Silica, in bags, 325 mesh, ton	$20.00@$40.00
Sulphur, Texas, mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.50@$10.50
Vermont, extra white, 200 mesh	$9.50@$10.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50
200 mesh, cream colored	$26.00

(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$23.50
Basic	$22.50
No. 2 Foundry	$23.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$34.00
Structural shapes, 100 lb	$2.10
Bars, 100 lb	$2.15

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1939	1940	1939	1940	1939	1940
January	42.750	34.750	20.305	21.892	466.775	395.442
February	42.750	34.750	20.370	20.935	468.472	395.652
March	42.750	34.750	20.280	20.763	468.370	375.212
April	42.750	34.750	20.031	20.713	467.778	351.817
May	42.750	34.949	20.123	21.878	467.988	326.452
June	41.955	34.825	19.505	22.688	468.137	359.560
July	34.944	34.750	16.952	22.095	468.031	379.750
August	35.951	34.750	17.719	23.261	460.383	396.889
September	36.956	.....	22.178	.....	398.820	.....
October	35.726	.....	22.736	.....	400.350	.....
November	34.750	.....	23.378	.....	391.457	.....
December	34.956	.....	23.263	.....	391.830	.....
Year	39.082	.....	20.570	.....	443.199	.....

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine, London pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot (a)			
	Domestic		Export		Standard		Electrolytic	
	1939	1940	1939	1940	1939	1940	1939	1940
January	11.025	11.954	9.912	11.999	43.125	(b)	48.440	(b)
February	11.025	11.148	9.735	11.471	42.188	(b)	47.375	(b)
March	11.025	11.160	9.888	11.407	42.938	(b)	48.120	(b)
April	10.265	11.087	9.820	11.258	42.031	(b)	47.833	(b)
May	9.833	11.079	9.738	11.191	41.656	(b)	47.528	(b)
June	9.775	11.128	9.738	11.216	41.986	(b)	47.528	(b)
July	9.976	10.564	9.944	10.189	42.899	(b)	48.863	(b)
August	10.261	10.708	10.211	9.851	44.685	(b)	50.409	(b)
September	11.635	.....	11.685	.....	(b)	.....	(b)	.....
October	12.215	.....	12.491	.....	(b)	.....	(b)	.....
November	12.275	.....	12.929	.....	(b)	.....	(b)	.....
December	12.275	.....	12.631	.....	(b)	.....	(b)	.....
Year	10.965	.....	10.727	....	(c) 42.689	.....	(c) 48.262	.....

New York quotations, cents per pound. London, pounds sterling per long ton. (a) Bid quotations. (b) No quotations. (c) Average for eight months.

LEAD

	New York		St. Louis		London			
	1939	1940	1939	1940	1939 Spot	1939 3 mos.	1940 Spot	1940 3 mos.
January	4.826	5.471	4.676	5.321	14.534	14.744	(a)	(a)
February	4.805	5.076	4.655	4.926	14.283	14.417	(a)	(a)
March	4.824	5.192	4.674	5.042	14.660	14.860	(a)	(a)
April	4.782	5.071	4.632	4.921	14.337	14.533	(a)	(a)
May	4.750	5.015	4.600	4.865	14.483	14.679	(a)	(a)
June	4.800	5.000	4.650	4.850	14.564	14.651	(a)	(a)
July	4.854	5.000	4.704	4.850	14.753	14.856	(a)	(a)
August	5.043	4.854	4.893	4.704	16.040	15.885	(a)	(a)
September	5.449	.....	5.299	.....	(a)	(a)	.....	.....
October	5.500	.....	5.350	.....	(a)	(a)	.....	.....
November	5.500	.....	5.350	.....	(a)	(a)	.....	.....
December	5.500	.....	5.350	.....	(a)	(a)	.....	.....
Year	5.053	.....	4.903	....	(b) 14.707	(b) 14.828	.. ..	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton. (a) No quotations. (b) Average for eight months.

TIN

	Straits New York		Standard, Spot London	
	1939	1940	1939	1940
January	46.404	46.707	215.435	240.716
February	45.640	45.851	213.906	242.833
March	46.213	47.079	215.375	251.711
April	47.160	46.815	218.389	252.080
May	49.031	51.570	225.591	264.098
June	48.853	54.618	227.511	273.438
July	48.548	51.591	229.833	265.592
August	48.793	51.176	229.869	262.455
September	64.588	.....	229.292	.....
October	55.580	.....	229.943	.....
November	52.322	.....	230.000	.....
December	50.740	.....	248.974	.....
Year	50.323	.....	226.177	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1939	1940	1939 Spot	1939 3 mos.	1940 Spot	1940 3 mos.
January	4.500	5.644	13.682	13.887	(a)	(a)
February	4.500	5.534	13.522	13.780	(a)	(a)
March	4.500	5.750	13.728	13.961	(a)	(a)
April	4.500	5.750	13.443	13.637	(a)	(a)
May	4.500	5.803	13.717	13.938	(a)	(a)
June	4.500	6.235	14.023	14.223	(a)	(a)
July	4.516	6.250	14.235	14.435	(a)	(a)
August	4.719	6.389	14.628	14.761	(a)	(a)
September	6.104	.....	(a)	(a)	.....	.....
October	6.500	.....	(a)	(a)	.....	.....
November	6.500	.....	(a)	(a)	.....	.....
December	5.980	.....	(a)	(a)	.....	.....
Year	5.110	.....	(b) 13.872	(b) 14.078	.....	.....

St. Louis quotations, Prime Western, cents per pound. London, pound sterling per long ton. (a) No quotations. (b) Average for eight months.

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1939 (a)	1940 (a)	1939	1940
January	58.400	79.038	20.000	20.000
February	55.000	80.000	20.000	20.000
March	54.259	80.000	20.000	19.769
April	50.000	80.000	20.000	19.000
May	50.000	80.000	20.000	19.000
June	50.000	80.000	20.000	19.000
July	50.000	80.000	20.000	19.000
August	53.704	80.000	20.000	18.000
September	64.200	.....	20.000	.....
October	74.600	.....	20.000	.....
November	75.000	.....	20.000	.....
December	75.000	.....	20.000	.....
Year	59.180	.....	20.000	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound. (a) Producers' price, commercial sticks.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1939	1940	1939	1940	1939	1940
January	11.670	14.000	77.440	156.962	34.440	40.000
February	11.250	14.000	85.227	178.000	35.000	40.000
March	11.269	14.000	87.278	180.921	35.000	40.000
April	11.500	14.000	90.800	173.538	35.000	38.923
May	11.712	14.000	86.769	181.538	35.000	38.000
June	12.000	14.000	86.615	197.360	35.000	38.000
July	12.000	14.000	86.960	194.423	35.000	38.000
August	12.000	14.000	84.407	184.111	35.333	38.000
September	12.910	.....	140.000	.....	40.080	.....
October	14.000	.....	145.600	.....	41.120	.....
November	14.000	.....	134.978	.....	40.000	.....
December	14.000	.....	141.200	.....	40.000	.....
Year	12.359	.....	103.940	.....	36.748	.....

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk 13.415 for August. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum, dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1939	1940	1939	1940	1939	1940
January	21.50	23.50	20.50	22.50	21.00	23.00
February	21.50	23.50	20.50	22.50	21.00	23.00
March	21.50	23.50	20.50	22.50	21.00	23.00
April	21.50	23.50	20.50	22.50	21.00	23.00
May	21.50	23.50	20.50	22.50	21.00	23.00
June	21.50	23.50	20.50	22.50	21.00	23.00
July	21.50	23.50	20.50	22.50	21.00	23.00
August	21.50	23.50	20.50	22.50	21.00	23.00
September	22.50	.....	21.50	.....	22.00	.....
October	23.50	.....	22.50	.....	23.00	.....
November	23.50	.....	22.50	.....	23.00	.....
December	23.50	.....	22.50	.....	23.00	.....
Year	22.083	.....	21.083	.....	21.583	.....

Iron, dollars per long ton. F.o.b. Mahoning and Chenango Valley furnaces.

PERSONAL ITEMS

Harold Taylour has been elected president of the New Guinea Mining Association.

Paul W. Long is employed as mine and tunnel foreman, classified service, at Gatun, Canal Zone.

Van H. Smith, of North American Cyanamid, Ltd., Toronto, is in British Columbia on research work.

W. H. Smith has succeeded **K. M. Chambers** as manager of Normanby Tin, N. L., Cooktown, Queensland.

Robert S. Moehlman, mining geologist, has moved his office from Inspiration, Ariz., to 600 Gordon Ave., Reno, Nev.

I. G. Irving is returning to the Pacific Coast after completing two years of post-graduate study in geology at Harvard.

Arthur Johnson, mine superintendent of Big Bell Mines, Ltd., Big Bell, Western Australia, has resigned his position and has left on return to America.

Robert M. Hannah, who has been on the metallurgical staff of Burma Corporation, Ltd., for the past four years, has returned to Australia.

M. R. McKeown has been appointed consulting engineer to Consolidated Gold Areas, N.L., and Blue Spec Mines, N.L., both operating in Western Australia.

Arthur Johnston recently resigned from his position of mine superintendent at Big Bell Mines, Big Bell, W. A., to return to the United States.

H. Merriweather, in charge of mine operations for the Bethlehem Steel Company, and **M. L. Jacobs,** vice-president, were recent visitors on the Mesabi range.

L. E. Hanley, president and general manager of Hecla Mining Company (Wallace, Idaho), and **L. J. Hoban,** treasurer, were in New York late in July.

C. P. Browning, general manager of Britannia Mining & Smelting Company, has returned to the British Columbia operation from New York.

S. S. Holland and **M. S. Hedley,** provincial resident mining engineers of British Columbia, have been attached to the Alaska-Yukon route surveys this year.

W. M. Morgan, formerly with Lake George Mines, Ltd., Captain's Flat, New South Wales, has joined the construction staff of the State Electricity Commission, Victoria.

Wendell W. Fertig, lately with the Santa Rosa Mining Company, Camarines Norte, P. I., is now associated with Samar Mining Company, P. O. Box 119, Tacloban, Leyte, P. I.

Stewart Campbell, of Boise, Idaho, former Inspector of Mines for that State, has assumed the post of general manager of the Queen mine, at Bellevue, Idaho.

George Ridgway has retired from the position of managing director of Lancefield (W. A.) Goldmine, N. L. He was one of the vendors of the property to the present company.

R. A. Rutherford, formerly general manager of Gold Mines of Papua, Ltd., is in charge of development operations for Sylvia Gold, Silver & Base Metal Mines, N.L., Tararu Creek, Thames, New Zealand.

Dwight Moody, engineer, has resigned his position with the United States Bureau of Reclamation and will develop a chromium property, known as the Twin Sisters, in northwestern Washington.

E. G. Dentzer, until recently assistant general manager of Magma Copper Company at Superior, Ariz., on Aug. 1 assumed the position of general manager of the company, succeeding the late William Koerner.

Edward H. Wisser, consulting mining geologist, has returned to his office at 74 New Montgomery St., San Francisco, from a professional trip to the property of Mexican Candelaria Company, Contra Estaca, Sin., Mexico.

Fred W. Denton has been appointed superintendent of the New Brunswick mine of Idaho Maryland Mines Corporation, Grass Valley, Calif., succeeding **J. F. Cowley,** who is now manager of West Coast Mines, Inc., Winnemucca, Nev.

Dr. Réné, consulting metallurgist and chemist of San Francisco, and **Rudolph Delamar,** dredge engineer, formerly with the New York Engineering Company, New York, recently have left San Francisco via Clipper for Manila, P. I., to join the staff of Marsman & Company.

Frank C. Olive, attorney of Indianapolis and president of the Smith Valley Gold Mines, Inc., a reorganization of the Ambassador Gold Mines, Ltd., recently inspected the company's large placer properties in Lyon County, Nev.

J. N. Lowman, of Cleveland, Ohio, president of Basic Ores, Inc., has been at the company's property in northern Nye County, Nev., from which a large volume of brucite is shipped, after sorting and crushing, to the company's processing plant at Maple Grove, Ohio.

Frank W. Collins, mechanical engineer for Pan-American Engineering Corporation, Ltd., has returned via plane to headquarters at 820 Parker St., Berkeley, Calif., from Alaska, where he visited the placer operations of Fairbanks Exploration Company at Fairbanks, and the mine and concentrator of Alaska Juneau Gold Mining Company at Juneau.

A. E. Stanton, who has been auditor of American Zinc Company of Illinois, has been promoted to the position of vice-president. He will be situated in the general offices of the company in St. Louis.

Julio Bascunan, representing Cia. Aurifera Rosario de Andacollo, Calle Catedral 1645, Santiago, Chile, recently returned to Chile following a business trip to New York City.

Lewis A. Grant, for many years with the Hecla Company mills in the Coeur d'Alenes, has accepted a position with the American Zinc, Lead & Smelting Company, as superintendent of the Grandview mill.

Harry J. Wolf, mining engineer of New York, examined mining properties near Kaslo, British Columbia, during August, and visited Nelson and Vancouver, B. C., Seattle, Wash., and Denver, Colo., on professional business, traveling the longer distances by airplane.

Courtney E. Cleveland, having completed his post-graduate course in Geology at McGill University, Montreal, obtaining the degree of Ph.D., is now connected with the exploration department of Bralorne Mines, Ltd.

Gilbert A. LaBine, president of Eldorado Gold Mines, Ltd., and Gunnar Gold Mines, Ltd., has been appointed a governor of the University of Toronto. Mr. LaBine made the original discovery of radium-silver pitchblende ores, Great Bear Lake, N. W. T.

Clifton W. Livingston has resigned as assistant general superintendent of Baguio Gold Mining Company, Baguio, P. I., after spending over three years in the Philippines. He returns to the United States as instructor in the mining department at Michigan College of Mines and Technology, Houghton, Mich.

P. J. Thibodeaux, Jr., is on a six months' leave after spending three and a half years in the Philippine Islands in the capacity of metallurgical engineer for Southwestern Engineering Company of P. I.

Colonel L. B. Lent, of New York City, has been named executive secretary of American Engineering Council, succeeding **F. M. Feiker,** who resigned recently to become dean of engineering at George Washington University. Colonel Lent has already assumed his work in the offices of Council, 919 - 17th St., N. W., Washington, D. C.

Richard N. Hunt, geologist, recently examined silver-lead properties in the Eureka, Nev., district, reputedly on behalf of the United States Smelting, Refining & Mining Company, of Salt Lake City, owner of former large producers in that area.

Fred C. Grube, custodian for many years of once-productive silver mines at Candelaria, Nev., and now living at Los Altos, Calif., has taken up temporary residence in the old Nevada camp to supervise activities of a number of lessees now making regular smelter shipments.

E. A. Julian and **Herbert N. Witt,** respectively chief engineer and geologist for the Goldfield Consolidated Mines Company, have been outlining new work.

core drilling, and plant improvement at the Dixie Valley gold property of the Comstock Keystone Mining Company, now controlled by Goldfield Consolidated.

Herbert C. Enos, mining engineer, formerly general manager of Lane Rincon mine, at Temascaltepec, Mexico, recently returned to his present headquarters at Chatsworth, Calif., from Carrizozo, N. M., after sampling the Parsons gold-molybdenum mine. He has a six-year bond and lease on the property and intends to start development soon.

Lincoln R. Page, of the United States Geological Survey, has spent several weeks searching for and testing rare metals, traces of which are found near Spokane. He is looking for tin, tungsten, and other strategic metals, included in the list of war minerals wanted by the government and has given a gerat deal of attention to the tin deposits. ten miles south of Spokane. **Charles P. Robbins,** of Spokane, represents the owners of this tin property.

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OBITUARY

Sterling C. Hines, a mining engineer and consultant, of Los Angeles, died on Aug. 19 in that city.

Alfred J. J. Moore, a consulting mining engineer, recently died in Melbourne, Australia, at the age of 66.

J. V. W. Mathers, business manager of Western Mining Corporation, Ltd., Kalgoorlie, W. A., died in Perth, W. A., on June 11, aged 63.

A. J. J. Moore, connected for many years with the Bendigo mining field, Victoria, as a consulting engineer, died in Melbourne on June 25, at the age of 66.

William Fagergren, 52, metallurgist and inventor of flotation equipment, died on Aug. 17 at his Salt Lake City home after an illness of several months. Mr. Fagergren's flotation machine is used in mining properties all over the world.

R. Beresford Ash, underground manager of the Great Boulder mine, Kalgoorlie, Western Australia, recently died at Kalgoorlie, aged 47. He was an associate of the Royal School of Mines and an associate member of the Institution of Mining and Metallurgy, London.

Dr. William Catto, 72, veteran physician of the Yukon, who went into that district more than 40 years ago, died recently in the Vancouver, B. C., hospital. He sustained injuries when knocked down by an auto. He was born at Aberdeen, Scotland, and was a graduate of the Edinburgh and Heidelberg universities.

W. Frechville, mining engineer, metallurgist, and geologist, long a consulting engineer in London and active in the mining industry in the Transvaal and India, died on July 30 last at the age of 86.

Dr. Philip Krieger, mining engineer and geologist, assistant professor of geology at Columbia University, died at Gouverneur, N. Y., on Aug. 19, from injuries sustained when his automobile overturned near Edwards, N. Y. He was 39, and had been a member of the faculty at Columbia for twelve years. He had this summer been acting as consulting geologist for the American Metal Company, conducting research at Gouverneur. Dr. Krieger received his Ph.D. degree from Columbia in 1932 and had done extensive geological work in the Southwestern United States and northern Mexico before his assumption of professional work at Columbia. He was a fellow of the Society of Economic Geology and a member of the Mineralogical Society, the New York Academy of Science, and the A.I.M.E.

Dr. John Eliot Wolff, professor emeritus of geology at Harvard, was found dead in the Mojave Desert by a searching party on Aug. 12. He had left Pasadena, Calif., on Aug. 7 to make a survey of Mint Canyon and had been overcome while trying to extricate his auto, which had become stalled in sand about 100 miles northeast of Los Angeles. Dr. Wolff was a graduate of Harvard, receiving his doctorate in 1889. He had been an instructor in geology and related subjects at that university until he became professor emeritus in 1923. He was a member of the Geological Society of America and of several other scientific bodies.

Ralph T. Mishler, general manager of The Fresnillo Company, Fresnillo, Zacatecas, Mexico, died after a short illness at Temple, Texas on July 22. He was born in Springfield, Mo., Feb. 9, 1880, and moved to California when about seven years of age. He received his early education in the Pamona public schools and then attended the University of California, from which he was graduated with honors in 1905. He was a member of the Sigma XI Scientific Honor Society, and of the Phi Kappa Sigma Fraternity. In later years he took his Masters Degree of E.M. at the University of Arizona. His first mining work after graduation was at Randsburg, Calif., and a year later he joined the staff of the Republican Mining and Metal Company in Mexico as field engineer. In about 1908 he was employed by the American Smelting & Refining Company at its Angangueo unit located near Mexico City as engineer and later became mine superintendent. In 1910 the Lucky Tiger Combination Gold Mining Company was getting under way an expansion program at the Tigre Mining Company in Sonora, Mexico, and there he became assistant general manager. In a few years he became general manager of this company and its other subsidiaries. In 1935 he joined the staff of the Fresnillo Company, which he was serving as general manager at the time of his death.

Dr. Rudolf Gahl died in Lima, Peru, last June 29, after an illness of two months. He was operated upon for cancer and did not survive the operation. Dr. Gahl's home address was 1155 Laurel St., Berkeley, Calif., but for the last five years he and his wife had been living in Peru, where he was engaged in metallurgical work. He was born in Berlin, Germany, in 1875, and was educated in that country, receiving his Ph.D. degree from the University of Goettingen, but practically all of his active life was spent in America and for many years he had been a citizen of the United States.

AN APPRECIATION

Dr. Gahl came to America in 1904 and soon after settled in Denver, Colo., where he purchased an assay office and laboratory. Two years later he joined the staff of the Phelps-Dodge Corporation in Arizona, and thereafter he was engaged chiefly in metallurgical work until his death. He made some valuable contributions to hydrometallurgy, especially in flotation. A number of patents were issued to him covering these developments, and altogether he published some twenty-five papers on various scientific subjects. He was a profound scholar, with inventive genius.

Those who knew Dr. Gahl best appreciated him most. His integrity and forthrightness were apparent to the most casual acquaintance. Although his manner and bearing may have appeared to a stranger to be somewhat austere, his nature was most kindly, and those who knew him well felt his friendliness and kindliness as soon as they came into his presence. He enjoyed company, and it might surprise some of his former business associates to learn that he particularly liked home social gatherings where people indulged in parlor games and simple amusements, even if he did not take a very active part himself. He was really far from being austere, and was a very lovable character.

Rudolf Gahl was a staunch friend and a likable, although not a voluble, companion. If you were a close friend you enjoyed just being with him, even though both of you spent much of the time sitting and simply looking into the fireplace. His many friends will greatly miss him, and his profession has lost an able scientist.

CHARLES A. ROSE

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A LETTER

Differential Density Separation at Mascot

IN REFERENCE to the article on M.B.I. differential density process at Mascot, I wish to draw your attention to an inaccuracy in the footnote on page 35 in your July issue.

This refers to the use of the process at Mascot and at Eagle-Picher Central Mill and states "the entire tonnage at both properties is being handled by this process."

As a matter of fact (checked with E.-P. M. & S. office), at E.-P. Central Mill the minus 3/16" from the feed goes direct to Bendelari jigs. I might add that the cone concentrate, after being reground, goes to Bendelari jigs to be brought up to shipping grade.

F. N. BENDELARI

Joplin, Mo.

What Metal Statistics Show

CONSUMPTION OF COPPER, lead, and zinc is steadily increasing as the national defense program gathers momentum, and some producers have announced plans to increase output. The American Zinc, Lead & Smelting Company started operations of its zinc properties in Washington and also announced plans for rehabilitating the electrolytic zinc plant at Monsanto, Ill., recently purchased from the Evans-Wallower Company.

The price rise in copper from 11 to 11½c., Valley, on Sept. 5 brought out the highest single day's volume of sales on record, involving 115,352 tons. Observers believe production and consumption of copper are approaching balance.

The July statistics of the Copper Institute showed stocks of refined metal at the end of the month of 215,823 tons, a gain of 16,237 tons compared with a month previous. Stocks of blister copper decreased 11,472 tons during July, so that the net gain in total stocks was only 4,765 tons.

Domestic deliveries increased from 61,716 tons in June to 71,226 tons in July. Over the first seven months of the year, domestic deliveries averaged 70,013 tons a month.

The duty-free copper statistics for the first seven months of 1940, in short tons, follow:

	Production	
	(a) Crude	Refined
January	89,598	80,501
February	76,145	82,761
March	85,796	86,295
April	84,366	80,964
May	82,682	86,029
June	(b) 79,845	86,077
July	79,523	90,995
Totals	577,955	593,622

	Deliveries to Customers		
	Domestic	Export	Totals
January	91,428	13,117	104,545
February	63,215	9,594	72,809
March	64,376	7,517	71,893
April	68,665	2,974	71,639
May	69,467	7,018	76,485
June	61,716	3,439	65,155
July	71,226	3,532	74,758
Totals	499,093	47,191	537,284

	(c) Refined Stocks End of Month
January	135,441
February	145,393
March	159,795
April	169,120
May	178,664
June	199,586
July	215,823

(a) Mine or smelter production or shipments, and custom intake including scrap. (b) Corrected. (c) At refineries, on consignment and in Exchange warehouses, but not including consumers' stocks at their plants or warehouses.

Monthly sales of copper by producers for delivery to United States consumers, in short tons, follow:

	1939	1940
January	15,399	24,987
February	23,361	147,112
March	28,618	20,305
April	59,874	41,701
May	59,026	83,879
June	66,786	110,453
July	183,151	58,577
August	38,299	67,281
September	183,877	.....
October	68,423	.....
November	51,630	.....
December	28,798	.....
Total	807,242	.....

▶ LEAD—Stocks of refined lead in this country at the end of July amounted to 47,360 tons, a reduction of 7,983 tons compared with a month previous. Shipments of 52,560 tons for July were the largest since last November. The figures for June and July, in tons, follow:

	June	July
Stock at beginning	62,955	55,343
Production:		
From domestic ore	34,041	35,343
Secondary and foreign	8,265	9,253
Totals	42,306	44,596
Domestic shipments	49,904	52,560
Stock at end	55,343	47,360

▶ SILVER—Production of silver in the United States (refinery basis) for June amounted to 5,373,000 oz., against 5,840,000 oz. in May. Output for the first six months of 1940 amounted to 33,540,000 oz., against 29,534,000 oz. in the same period last year.

▶ PLATINUM—Preliminary figures on production of new platinum and platinum metals in the United States during 1939 indicate an output of 43,769 oz., against 48,269 oz. in 1938, according to the annual survey of the industry by the Bureau of Mines. The figures on crude for 1938 and 1939, in ounces, follow:

	1938	1939
Placer platinum	40,932	(a) 35,060
Ore (platinum content)	90	66
From refineries (b):		
Platinum	3,761	5,270
Other Pt metals	3,486	3,364
Totals	48,269	43,769

(a) Subject to revision. (b) New metals recovered in gold and copper refining of domestic materials.

Returns for 1939 on placer operations accounted for 33,900 oz. from Alaska, 1,140 oz. from California, and 20 oz. from Oregon, a total of 35,060 oz.

E & M J Weighted Index of Non-Ferrous Metal Prices

(100 is composite for 1922–3–4)

1929	110.33	1934	69.59
1930	82.87	1935	74.66
1931	60.20	1936	73.45
1932	48.26	1937	90.86
1933	59.79	1938	73.67
		1939	77.71

	1938	1939	1940
January	75.56	77.12	80.85
February	73.43	76.89	77.23
March	72.41	77.09	77.94
April	71.19	74.79	77.19
May	69.15	73.61	77.68
June	67.55	73.17	78.85
July	72.95	71.95	76.72
August	73.94	73.88	76.71
September	74.70	83.07	....
October	77.61	84.25	....
November	78.36	83.80	....
December	77.13	82.89	....

▶ ZINC—The July and August statistics of the American Zinc Institute, covering all grades, are summarized as follows in tons:

	July	August
Stock at beginning	65,227	58,796
Production	(c) 51,175	49,939
Production, daily rate	(c) 1,651	1,611
Shipments	(a) (c) 57,606	(b) 64,065
Stock at end	(c) 58,796	44,670
Unfilled orders	63,726	69,508

(a) Includes 1,710 tons exported. (b) Includes 2,935 tons exported. (c) Revised.

Figures on operations of the Prime Western division alone, for the first eight months of the year (January to June revised), in tons, follow:

	Production	Shipments	Stock At End
January	19,930	25,240	24,742
February	22,542	20,017	27,267
March	23,846	20,401	30,712
April	21,742	20,034	32,420
May	21,173	24,292	29,301
June	19,302	23,143	25,460
July	20,698	26,139	20,019
August	21,224	27,774	13,469

▶ QUICKSILVER—Domestic production of quicksilver during June amounted to 3,000 flasks, according to the monthly report on operations in that industry by the Bureau of Mines. Output in May came to 3,100 flasks, and in April to 2,700 flasks. Last September, before the rise in prices influenced production, output in the United States was down to 1,500 flasks.

Production during June in California was at a higher rate than in the month previous. Output in Oregon and Nevada was slightly lower in volume during June than in the preceding month.

▶ MANGANESE — Domestic production of manganese ore containing 35 per cent or more of manganese during the month of June was 2,600 long tons, against 2,300 tons in May, according to the monthly manganese survey by the Bureau of Mines. Shipments of domestic ore totaled 2,300 tons during June and stocks in producers' hands at the end of the month amounted to 2,500 tons.

▶ MAGNESIUM — The Dow Chemical Company, Midland, Mich., announced in August that its capacity to produce metallic magnesium is being increased to 25,000,000 lb. a year. This higher rate of production will become available by December of the current year. In 1939, the production totaled 10,650,121 lb., based on sales reported to the United States Bureau of Mines. All domestic production last year came from the plant at Midland, Mich.

Hydraulic gold mining operations are in full swing in several districts in California. The view above shows the operation of the Joubert hydraulic mine near Camptonville, Calif.

CALIFORNIA

Mill Being Planned For Harvard Mine

Diamond drilling program fulfilled at property, and Alaska Juneau Gold Mining Company plans erection of 500-ton plant—Kennedy Mining & Milling Company completes shaft sinking

▶The diamond-drill and sampling campaign started more than a year ago as a preliminary to actual operation of the Harvard mine, at Jamestown, Tuolumne County, by the Alaska Juneau Gold Mining Company, P. R. Bradley, president, has been completed, and checking of results and lateral development by drifting are now in progress. Underground workings at the Harvard (under lease to Alaska Juneau) extend to a depth of 1,400 ft., but all exploration work carried out so far by the present operators has been confined mostly above the 500 level. Future plans include erection of a 500-ton milling plant, for which details are now being drawn up. P. R. Bradley, Jr., who also manages the Pine Tree and Josephine property of Pacific Mining Company in Bear Valley, Mariposa County, is in charge of operations.

▶Kennedy Mining & Milling Company, E. C. Hutchinson, president, has completed the shaft-sinking work started a short time ago to intersect and subsequently develop the extension of an orebody worked on the 5,700 level, and is now advancing an exploratory drift from the newly established level. At the mill ten stamps are currently in operation crushing about 45 tons of ore a day. The 1,600-ton tailings re-treatment plant, which stopped operations some time ago, has been sold and the equipment is being dismantled. Operations at the mine situated at Jackson, Amador County, are directed by Mark Eudy, acting superintendent.

▶Preliminary work preparatory to resumption of mining operations after completion of the Narrows débris dam in 1941 is in progress at the well-known Omega hydraulic mine, near Washington, Nevada County. The property was recently acquired under a purchase option by California interests which include K. R. Nutting, J. E. Little, H. F. Wolfinger, and L. L. Harris, officials of the Northwest Development Company active in the Sumpter mining area of Oregon. Theodore A. Larsen is superintendent.

▶Construction of a 150-ton mill is rapidly nearing completion at the chrome and manganese property of West Coast Chrome Company near Patterson, Stanislaus County. The holdings cover about 3,500 acres, which are under lease to the company. Material immediately available for milling includes more than 4,000 tons of 20 to 30 per cent ore. Executive officers of the company are Charles Hall and J. A. Thronson, of Portland, Ore., and 50 men are employed.

▶A group of leasers including V. Wiley, H. A. Weller, C. D. Helm, J. Helm, and E. R. Albert are now operating the Fred Veercamp mine, in Garden Valley, El Dorado County, following relinquishment of option by the Alhambra-Shumway interests. Production is shipped to the Black Oak mill, owned by Russell Wilson, a short distance from the Veercamp property.

▶Installation of a milling plant capable of handling from 50 to 100 tons of ore a day is reported to be under way at the Welch mine, near Greenwood, El Dorado County, acquired recently by the Deep Rock Mining Company, of Santa Barbara, H. O. Clarke, president. Development plans call for deepening the 110-ft. central shaft, one of three affording access to underground workings, an additional 300 ft., and lateral work, following installation of a modern surface plant. H. F. Goss is vice-president and general manager.

▶Dragline dredging operations have been started by E. A. Kent, Inc., on the Sanguinetti property, near Chinese Camp, Tuolumne County, the equipment consisting of a Marion dragline with a 2½-cu. yd. bucket and a floating washing plant designed to handle up 5,000 yd. of gravel per day. J. Rice is general superintendent.

▶The Oregon Hill Gold Mining Company, formed a short time ago, has a small crew at work on underground development at the Pacific, Oregon, and Harman holdings at Placerville, El Dorado County, with L. F. S. Holland, an official of the company, directing operations.

▶Construction of camp buildings and installation of mining machinery is in progress at the Brown Bear property, near Deadwood, Trinity County, leased recently to San Francisco interests by E. E. Erich, of French Gulch, Shasta County.

▶At the New Almaden quicksilver mine, about 12 miles from San Jose, Santa Clara County, reopened recently by New Almaden Corporation, stripping and sampling operations are proceeding according to schedule, and a reduction plant, consisting of a 5x60-ft. rotary furnace, condenser system, and other auxiliaries, is in course of construction. Mining at the pit is done by two ¾-yd. diesel shovels, four large dump trucks, and air is furnished by two electric-driven compressors. The corporation is controlled by Philadelphia interests, with C. N. Schuette, general manager.

▶Yuba Consolidated Gold Fields, Ltd., largest dredge operator in California, has increased its placer holdings in northern California by acquiring under a lease arrangement 336 acres of dredging land in the East Biggs district of Butte County. F. C. Van Deinse, vice-president of the company, is in charge.

▶The Hiway-40 mine, located just west of Auburn, has been in operation about five months. Development work has opened ore on the 150-ft. level, and A. N. Kangas, manager, has started to sink an additional 125 ft. to 275 ft. Twelve men are employed.

▶The Calmich Mining Company recently subleased all of its gold-bearing gravel properties in the Smartville district, to the Yuba Consolidated Gold Fields, of San Francisco. Officers of the Calmich Mining Company are Mack C. Lake, president, and C. S. Morbio, secretary.

R.F.C. Mining Loans

Mining Loans Approved by R.F.C. from Sept. 1, 1939, to June 30, 1940, are listed as follows:

Applicant	Amount Approved
ARIZONA	
Steve Loncar, Wickenburg.....	$15,000 (this includes a previous loan of $5,000
CALIFORNIA	
French Gulch Dredging Co., 1367 Russ Building, San Francisco.....	160,000
Oroville Gold Dredging Co., 2052 Bird St., Oroville, Calif.	180,000 (this includes a previous loan)
COLORADO	
So. Platte Dredging Co., 1805 Mills Tower, San Francisco..	750,000
WASHINGTON	
Arlington Mines, Inc., Commercial Bank Bldg., Okanogan, Wash.....	20,000
ALASKA	
Walter W. Johnson, 351 California St., San Francisco, Calif.....	250,000

Total amount of mining loans authorized, $15,173,100
Total amount of mining loans cancelled, $8,382,000
Total amount of mining loans disbursed, $5,971,409.40
Total amount of mining loan repayments and other deductions, $2,488,696.95

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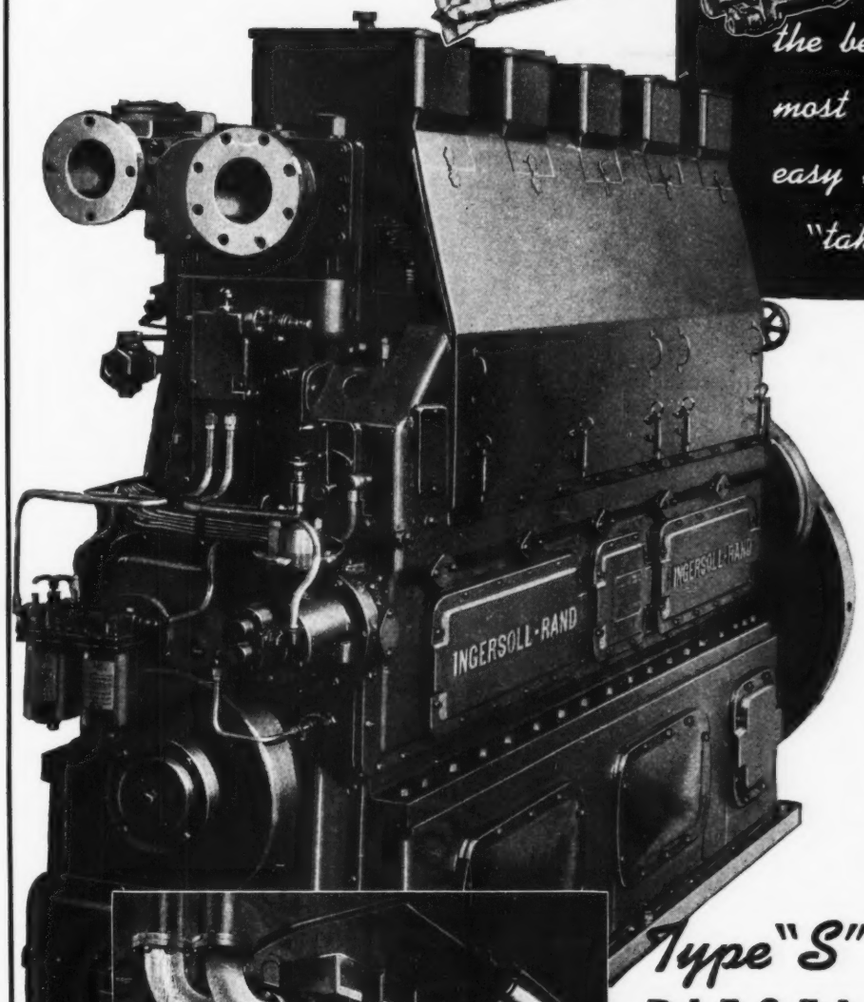

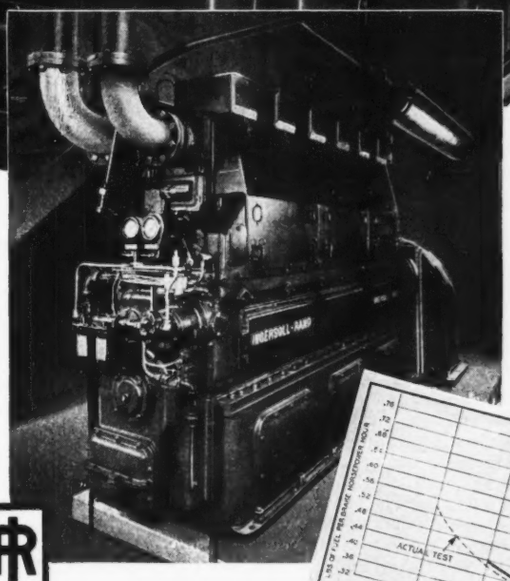

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3,4,5,6,7,8 cylinders
10½" x 12", 4 cycle
Send for Bulletin 10210

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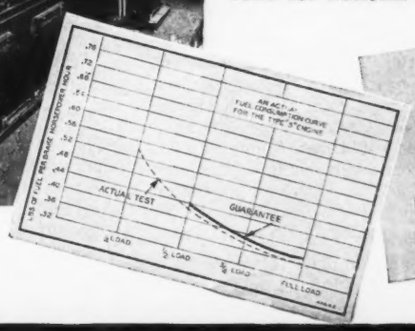

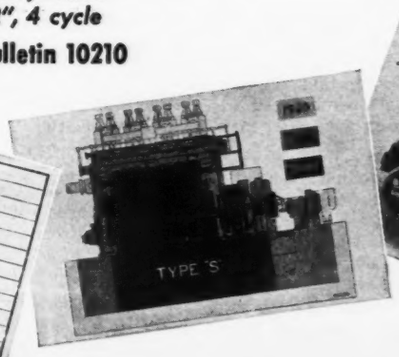

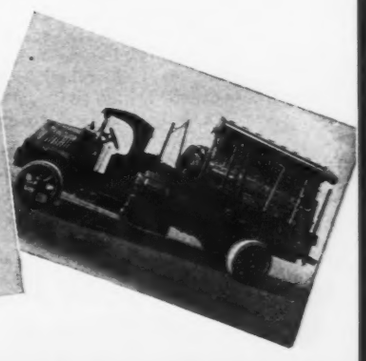

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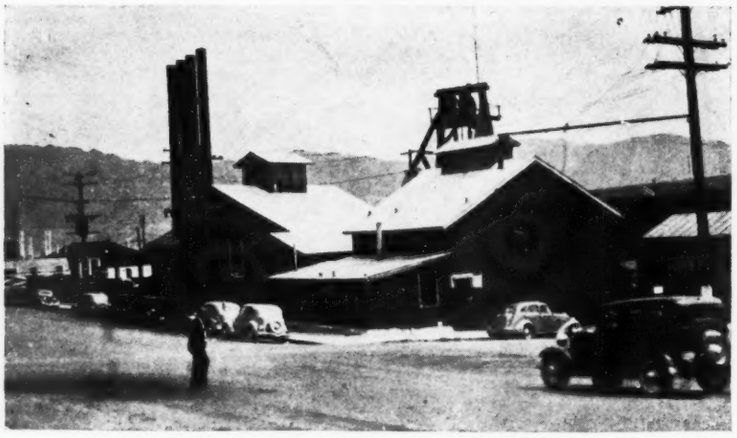

The uppermost portion of the headframe over the Emma shaft, operated by Anaconda Copper Mining Company under lease from the Butte Copper & Zinc Company, is shown near the center of the photograph. This zinc-manganese mine will provide the manganese ore for the new nodulizing plant scheduled for construction at Washoe, Mont.

MONTANA

Manganese Nodulizing Plant To Be Erected at Washoe

Anaconda Copper Mining Company signs three-year contract to deliver 80,000 tons of manganese concentrate to Metal Reserve Company—Mill at McLaren gold mine resumes operation

▶ On Aug. 6 a contract was signed by the Anaconda Copper Mining Company to produce 240,000 tons of nodulized rhodochrosite (manganese) ore for delivery to the Metals Reserve Company, a government agency set up by Congress under the National Defense Act. The contract requires production at a rate of 80,000 long tons a year for three years, but allows nine months for the construction of new plants necessary. The latter includes a nodulizing plant at Washoe and conversion of copper concentrator units to accommodate manganese ores which will require an expenditure of $1,500,000. The ore will be derived largely from the Emma mine of the Butte Copper & Zinc Company, which is operated under lease by the Anaconda Copper Mining Company. It is estimated that about 250,000 short tons of crude ore will be mined each year, to yield 80,000 long tons of concentrate which will be accumulated at Anaconda and held ready for emergency distribution.

▶ For several months production at the McLaren gold mine, near Cooke city, has been held up pending the completion of metallurgical tests. On Aug. 7, the reconditioned mill was started on a rate of about 100 tons a day. The revised flowsheet includes flotation, tables, and cyanidation of tails, with all units electrically driven by newly installed diesel plants. Work at the mine, which is about five miles from the mill, consists of preparations for open pit mining. A new lower bench is being cut, and it is expected that extensive ore reserves will be made available for removal to the mill next spring. The present run is being made on stockpiles now at the plant which may not permit continuance of the operation throughout the winter. Walter McLaren, of Dayton, Ohio, is in charge of all mining and milling operations.

▶ A research project directed toward the study of metallurgical problems pertaining to the recovery of manganese, tungsten, and chromite has been started under the supervision of Dr. S. R. B. Cooke, of the Montana State School of Mines. It is expected that the survey will be classed as a national defense project for which financing has been arranged through the allotment of $11,892 by the W.P.A. and $3,900 by the School of Mines. About fourteen workers will assist Dr. Cooke and approximately one year has been designated for completion of the project.

IDAHO

Hecla Mining Company Starts Atlas Shaft

Property recently acquired will be developed an additional 800 ft. in depth—Sherman Lead Company starts construction of 300-ton mill

▶Hecla Mining Company has started the sinking of the Atlas shaft, east of Mullan. Preparatory work has required four months' time and an expenditure of more than $100,000. Thirty men have been employed in three 8-hour shifts. The scene of operations is 9,000 ft. from the portal of a tunnel where a station 25 ft. wide by 50 ft. long and 12 ft. high has been cut for hoist installation.

▶Sherman Lead Company, operating the Sherman mine, at Burke, has started construction of a new 300-ton milling plant at the portal of the Hercules tunnel in Burke.

▶Dr. A. L. Heine, of Boise, will install a modern smelter at his property west of Bellevue. The smelter is of the latest type and is expected to pioneer a new era in that district. A complete laboratory and assaying equipment, including a spectograph, will also be installed, according to William Cohan, engineer in charge. Main recoveries will be gallium, worth $15 an ounce, and gold. Bullion will be shipped direct to the refinery at Selby, Calif.

▶The new 300-ton milling plant of the Coeur d'Alene Mines Corporation, south of Osburn, is nearing completion and operations will start by Oct. 1, according to Robert Bailey, engineer in charge. The plant will be an all-flotation unit and is constructed so that additional tonnage capacity can be added.

▶The Two Tails Lead-Silver Mining Company, operating near Bonners Ferry, is being developed by the Idaho Lead-Silver Company, of which J. A. Tormey, of Spokane, is president and J. C. Vernon, of Bonners Ferry, manager.

▶Grunter Mine, at Shoup, operated by the McLean brothers, will have the capacity of its mill increased from 100 tons to 300 tons following installation of a 1,000-hp. hydro-electric plant. The mine has a large deposit of low-grade gold ore on the banks of the Salmon River. L. L. McLean, of Shoup, is president; William McLean, mine superintendent.

▶Silver Dollar Mining Company, operating in the Coeur d'Alene district, has completed its main shaft to a depth of 2,500 ft. A crew of 32 men is employed.

▶ Sungold Mining Company, operating in the Orogrande district, recently uncovered a ledge of gold ore eight to 10 ft. wide and 1,000 ft. in length averaging around $15 per ton. Charles R. Hesseltine, manager, said samples gave returns of $421.75 in gold and $4.33 silver per ton. The company has installed a 30-ton Denver-type quartz mill with amalgamation plate and concentrator. Compressor machinery and other equipment are now being installed, which will be powered by steam, replacing gas equipment now in use.

▶Discovery of high-grade zinc-lead ore has been made at the Black Bear property, in the Burke district, according to A. W. Mackey, Butte mining engineer, in charge of the work. The ore is being shipped by truck to the Amy-Matchless mill, on Pine Creek, on a 70-ton-a-day basis.

▶Clayton Silver Mines, Clayton Salmon River district, recently opened a new vein of rich lead-silver ore which is reported to be proving larger than the vein from which production has been made for several years. Herman Marquardt, of Wallace, is president of the company.

▶The winze at the Jack Waite mine, Murray district, is reported to have uncovered new rich lead ore. Drifting on the 2,000 level has disclosed several lenses of high-grade ore running around 70 per cent lead.

▶ The Red Bird Mining Company, Custer County, owned by the Ford Motor Company, of Detroit, is reported to have men retimbering and repairing the tunnels.

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"NO PULL ON HOLDING HANDLE"

"There is no pull whatever on the holding handle. Even when running in very tight ground and no matter how tight the steel is in the hole, the hammer appears to make a complete stroke. Not once did I have to reef on the holding handle to free a bit, and the drilling was done in very hard and abrasive ground."

"POWERFUL—YET EASY TO HANDLE"

"It is a very powerful driller, and its balance makes it a dream to handle. No sludge whatever is getting down in the chuck. We have not heard one adverse remark from any of our runners about the R-104."

"BREAKS LOOSE QUICKLY"

"We ran a 5-ft. steel, then used a 7-ft. steel and a new bit of same gauge as used on the 5-ft. shanks, and drilled it to the bottom by placing the shank end on the boss of the holding handle and running the hammer. It was a tight fit, but when the operator ran the machine up on the steel, and opened the throttle, the machine broke it loose quickly and went on to finish the hole."

"SWEETEST STOPER HE EVER SAW"

"The R-104 Stoper is one of the sweetest stopers that I have ever seen. The balance and ease with which it starts a hole makes it a sweet drill. The push-button control is far superior and effective to any others now on the market. We have examined the R-104, which has had many hours of hard operation, and have found no signs whatsoever of sludge in the chuck, or anywhere."

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GARDNER-DENVER SINCE 1859

NEWS FROM Washington

By Special Correspondent

DEFENSE PROBLEMS cannot be separated from politics. Regardless of the fine intentions of the military planners, it is inevitable that delays come from this fact. Perhaps the major delay during July and August has been so caused.

Very naturally, each Congressman and each Senator would like to have a generous share of defense contracts allocated to his district. For some, this is absolutely vital to reelection. The pressure exerted on the Defense Commission and the military departments is, therefore, considerable.

Even after the approximate location of a new plant or project is determined, there still remains the problem of getting the land with clear title, in an arrangement that is suitable for the government without payment of excessive prices for real estate. All this has taken time and has delayed certain important undertakings.

"It is For Defense"

EVERY NEW PROJECT, whether directly of military significance or not, gets the most attention these days in Washington if it adopts the motto "It is For Defense." Some strange folks now wear that patriotic label. One reads, for example, of the following studies as defense undertakings: "Economic conditions in Florida in 1939," "Trade Barriers in Michigan," "Wholesale Directory of South Dakota," "History of railroad freight rates affecting the southwest." All this is but one more evidence that democratic processes function poorly in an emergency period. Nevertheless, the situation is far from desperate, though government economy seems to be an altogether lost art.

More Federal control is being imposed. Immediate regulation of many kinds of business activity is being achieved with the encouragement of the New Deal planners. Few voices are raised in protest. Those few are shouted down as "profiteers," "economic royalists," and with other criticisms highly embarrassing even when wholly untrue.

By far the worst factor bothering the Defense Commission is Congressional oratory. Members of Congress talking for home consumption are taken too seriously by the over-sensitive industrialists working on Commission projects. One recent political blast of this sort was especially embarrassing regarding manganese. This is the old controversy about the prospect for a domestic industry. And despite real progress in official work there is danger that this outside comment may unwarrantably discredit the workers with the President.

Stockpile Progress

DESPITE ANNOYANCES there has been real progress in stockpile building. Substantial imports of almost every strategic metal have been accomplished. Tungsten and antimony from the Far East, antimony from Mexico, Oriental tin, and some of the minor non-metallic strategics are all moving into stockpiles, both government-owned and those of private industry. Substantial domestic development has been made in tungsten, some improvement in the antimony situation, and very real progress in quicksilver development.

There has been some talk that the government by zealous activity is interfering with commercial purchases. Once or twice there has been danger of this, but an appropriate coordinating technic has been worked out. When imports are available industry has the first call on them. Uncle Sam would in fact prefer that private companies buy and hold such materials. This reduces the Treasury burden. It also simplifies the business of the Procurement Division, the Defense Commission, and the military departments. Close cooperation with competent committees of the various industries, including the importers, seems now to have cleared away any chance for unfortunate competition.

Quicksilver production continues to gain and new reserves are being disclosed. The United States output is now approximating the domestic requirements. Two reports of the United States Geological Survey indicate attractive prospects in the Mount Diablo district of California (near San Francisco) and in an extension of the Bottle Creek district of Nevada. About this latter area a government comment says:

"Athough, in the engineering sense, there are no proved reserves, it is estimated, in the light of past production that the probable reserves of known dikes to a depth of 150 ft. would run around 3,000 flasks, of 76 lb. each. This can be mined profitably so long as the price of quicksilver remains at $125 or more a flask, according to the Geological Survey. Oreshoots mined in the dikes are commonly small but of high grade and average about 30 lb. of quicksilver to the ton."

Plenty of Tin?

MINERAL ECONOMISTS in Washington are really worried about one feature of the tin program. This worry comes from the attitude of certain industrial executives who are inclined to assert that "Any fears of a shortage of tin do not appear to be well founded." Those making sincere effort to build stockpiles and to insure commercial reserves in adequate quantity fear that such statements may discredit the proper program and actually prove a boomerang for the advocates of that philosophy.

There are very real shortages of tin in prospect if either Pacific transport or Netherland Indies production is interrupted even for short periods. Such interruption would not be a major calamity if the United States carried in stock a year's supply of this metal. But it does not. The total of reserves in public and private hands would not last more than six to eight months, depending on the restrictions of use that might be applied.

Real progress is being made in building stockpiles, and privately held stocks are growing. However, it is going to take quite a while to set up any workable program for United States smelting facilities comparable with the deficiency in United States supplies of tin. Late in August there were still only "discussions" of the possibility of building a tin smelter in the United States to process Bolivian ores.

Manganese Contracts

SEVERAL manganese purchase contracts have been arranged by the government. Approximately in the order of completion of negotiations have been the following:

1. Anaconda Copper Mining Company undertakes to deliver 80,000 long tons per year of manganese concentrate for a period of three years. The ore will be taken from the Emma mine, at Butte, and from the adjacent orebodies. Approximately $1,500,000 will be spent in plant improvements, including construction of a nodulizing plant and conversion of certain copper concentrating equipment for use in manganese benefication.

2. Cuban-American Manganese Corporation has agreed to increase by one-third the capacity of its plant at Cristo, near Santiago, Cuba. Thus this plant will be able to handle about 130,000 tons of ferro-grade ore per year, including some ore from small producers who now have no concentrating facilities to make their primary product marketable. Metals Reserve Company (the R.F.C. agency) will purchase from the company from 25,000 to 65,000 tons of ferro-grade ore each year for the next three calendar years. The production will be 50 per cent manganese or better, concentrated from typical Cuban ores of less than 20 per cent, using the flotation processes already developed.

3. Assistance has been tentatively pledged to Brazilian enterprise for expanding the transport capacity of Central Railroad of Brazil, especially with new locomotives and freight cars. Approximately $1,800,000 of new equipment is being bought in the United States. Thus chance for export of Brazilian manganese ore in increased quantities is assured by elimination of the transport bottleneck.

4. A definite proposal for developing Southwestern manganese with power from Boulder Dam by a commercially planned undertaking is under negotiation late in August. Details and tonnages are not yet announced at the time of writing.

5. Several other specific proposals, one of which is very promising, have been presented for development of manganese from the manganiferous iron ores of the Cuyuna range of Minnesota. A contract for a commercial undertaking of that sort is expected during September.

Several other specific proposals have been offered. Some of these approach closely to the requirements for approval

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by the Defense Commission and acceptance by R.F.C. Some actual domestic manganese production is, therefore, expected within the next twelve months. The price to be paid by the Government for the resulting concentrates varies from one project to another. Each proposal is judged on its own merit, and negotiated contracts are arranged with responsible backers of acceptable plans. Uniformity of price is not to be expected. Nor are some of the proposals necessarily those which might claim the lowest price for delivered ore. Certainty of production rather than price alone largely determines the acceptability.

In addition to these domestic and near-by contract arrangements the Government and industry are continuing to buy foreign ore from more remote sources as it is offered. Some sizable shipments from South Africa are expected, for example. The aggregate effect is a substantial growth of the reserves under both government and private control.

Plans With Canada

THE AGREEMENT between President Roosevelt and Prime Minister Mackenzie King of Canada for a joint military defense board stole the spotlight effectively. Almost universal approval of the general idea was first expressed, regardless of political affiliations. However, a more sober study of the program shows that whatever its military merit, one important result will be a substantial increase in the need for men and material from United States sources.

Before this agreement was announced, the military program contemplated: (a) A two-ocean Navy; (b) early training of the National Guard and the reserve officer corps; (c) selective service mustering of about a million and a half men for training for one year; (d) equipment for an active armed force of two million men; and (e) a permanent training program by which each young man will at some certain age, be brought up for training for a permanent citizen reserve.

The making of the Canadian announcement has resulted in quiet talk about Washington regarding enlargement of the program. The need for four million men and their equipment is privately admitted by those who assume that the United States under this new arrangement may be compelled to defend actively everything from Iceland to Cape Horn, and from Alaska to Chile. There has, of course, been no official adoption or announcement of this larger number as the plan for the active military force.

More Aluminum

VIGOROUS EFFORT has been made by Washington to stimulate aluminum production. Early developments were arranged with the Aluminum Company of America, which is building several plants for its own account with its own funds. The bottleneck in this program has been supply of power under conditions that would be tolerable for post-emergency plant operation.

On the first of August the Reconstruction Finance Corporation announced that it had agreed to make a loan of $15,800,000 to Reynolds Metal Company to build a new aluminum plant. This works is to be near Fairfield, Ala., using power from TVA. In making the announcement the government and company executives stated that this new plant would start in with mineral and produce primary pig aluminum. Presumably the product would be used by the company, which has long been a manufacturer of light alloy products but not hitherto a producer of primary metal. The source of bauxite and the method for alumina manufacture have not been announced. However, it may safely be assumed that R.F.C. felt confident of the availability of this raw material or it would not have granted the loan as it did.

Mineral Survey Results

THE BUREAU OF MINES during the fiscal year ended June 30, surveyed nine strategic mineral projects. The executives of the Bureau take considerable satisfaction in summarizing the results obtained. They think that they had a very good batting average under the circumstances.

Two very encouraging prospects were thoroughly explored. These demonstrate, in the opinion of the Bureau, that Uncle Sam has at least one antimony and one chromium reserve that can be counted on in an emergency. But the Bureau executives are careful to state that they do not claim commercial practicability for these areas. Rather, they point out that they are now proved-reserves, which could be called on in an emergency with the assurance that the metal needed is there, if price considerations can be neglected as they are in emergency periods.

The results of three surveys of reported tin and nickel occurrences were very discouraging. The other four projects showed the presence of certain minerals but not in too encouraging quantity or availability.

This field work of the mining division of the Bureau is continuing this year. Congress is expected to speed up operations a little later in the season; but delay in the expected supplemental appropriation is seriously handicapping plans for field work, much of which cannot be continued next winter because of climatic conditions.

New Monopoly Charges

THE DEPARTMENT OF JUSTICE is aggressively continuing anti-trust activities. During mid-August it brought civil suits in the Washington, D. C., district court against companies and officials of gypsum concerns. It is charged that patent licensing programs are used as a means of restraining competition in the products of this industry. There is charged "the intention of monopolizing, controlling distribution, and fixing prices at uniform and non-competitive levels."

This gypsum case again spotlights the charge that proper patents are frequently misused by industry. A similar charge is said to be pending against producers of magnesium. In that case, and in the case of certain other enterprises, international patent agreements are the particular objectives of department procedures.

Even late in August it was still uncertain whether the Department of Justice would proceed soon against certain large petroleum companies alleged to be violating fundamental requirements of anti-monopoly legislation. Specifically the effort of the Government is to be a dissolution of the great integrated enterprises. Production and refinery operations would, according to this plan, be divorced from the pipe line, transport, and marketing facilities.

This anti-integration program is accused of being a "disintegration" proceeding that is highly inappropriate at this time. Executives of the Defense Commission have, therefore, been examining the Department of Justice proposal with a view to commenting on the effect of any such proceeding on the preparedness program. It is unfair, industry spokesmen argue, thus to attack a great industry and simultaneously to ask it to make great new investment and take large additional financial risks for the benefit of the Government.

News "Fines"

New Tin Tax—Effective Aug. 11 exports from Netherlands Indies of tin ore and metallic tin are subject to a war export duty of 5 per cent ad valorem. This is in addition to previous duties and taxes. Tin users thus help pay the defense bill for the Indies.

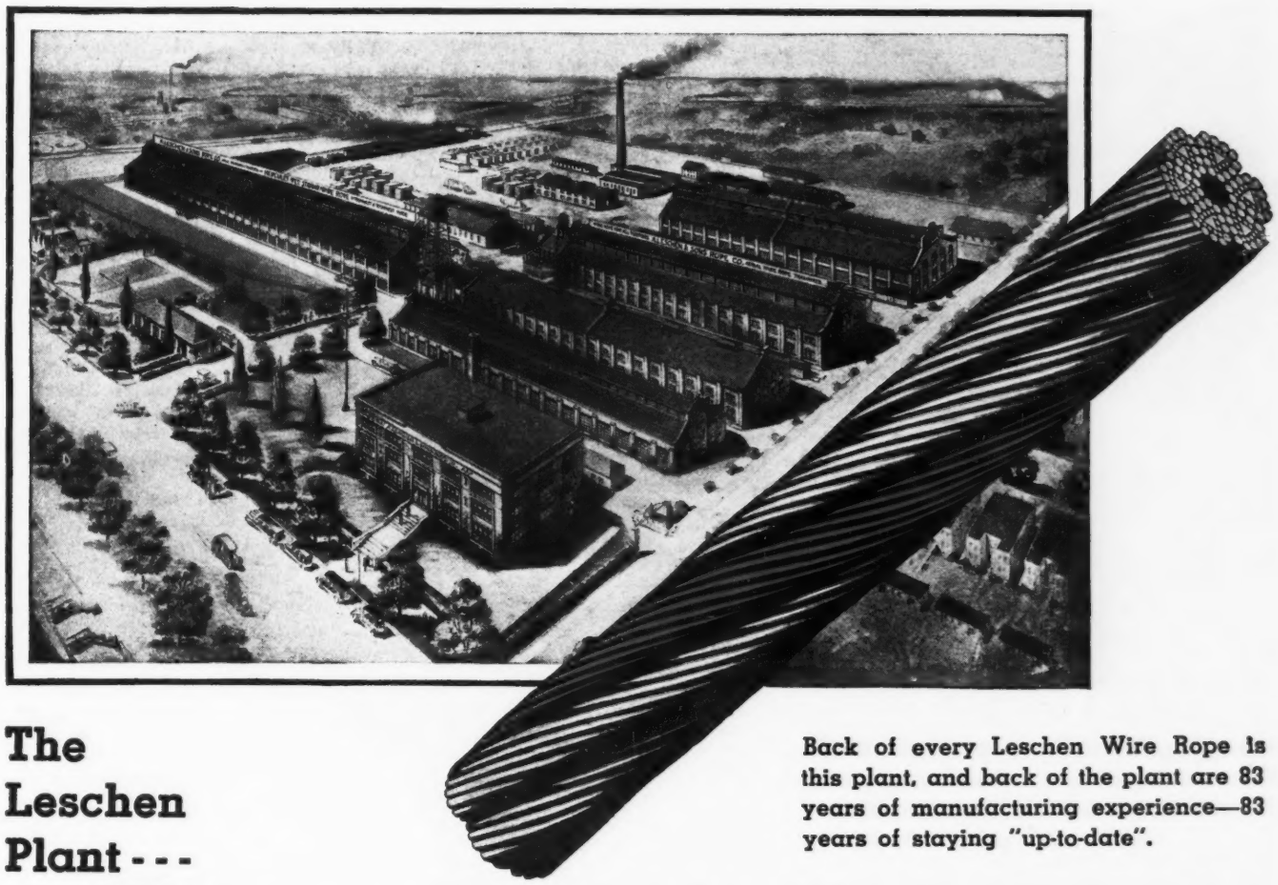
Mine Inspection—Congress has continued wrangling over the proposal that the Department of Interior be given additional authority for Federal inspection of mines. On Aug. 15 the effort was made to get this legislation out of the House mining committee, but a tie vote defeated Mr. Ickes' effort to secure control over coal mine safety. Metal miners, of course, are watching with almost equal interest because it is a short step into their mines once Interior gets started.

Veteran Preference—Personnel executives of the mining industry will need to be careful regarding the terms under which they release employees called for any sort of military duty. Congress is going to insist on some preference in reemployment of such people. The law has not yet been worked out. When it is it will be very important not to "fire" a man too casually.

New Labor Schedules—Effective on Oct. 24 the maximum work-week without overtime payment will be 40 hours. New personnel schedules must be ready by that date.

Learner Rules—Industries wanting learners, virtually apprentices who can be taught their job in a short period, now can have such workers under relatively simple rules of the Wage-Hour Division of the Department of Labor. But anybody trying to evade the minimum wage provisions by calling folks learners when they are not actually needed or not actually so situated will be subject to severe penalties.

Iron Mining—An elaborate report on trends in iron mining, particularly employment trends, has been reported by a WPA document which discusses "Technology, Employment, and Output Per Man in Iron Mining." The effect of mechanization on productivity is conspicuously treated.



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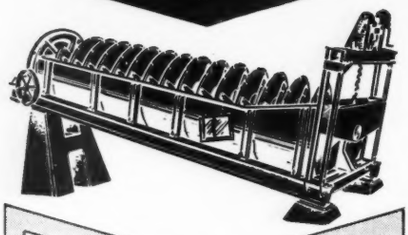

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NEVADA

Mountain City Copper Finds Ore Extension

Copper occurrence found on 1,000-ft. level is 300 ft. below present development—International Smelting & Refining Company contracts to operate property of Copper Canyon Mining Company

▶ Copper ore of good mill grade is said to have been opened on the 1,000-ft. level of the Rio Tinto mine of the Mountain City Copper Company, in northern Elko County, the deepest ore reported heretofore having been found on the 700-ft. level. Concentrate from the 300-ton flotation mill, together with an approximately equal tonnage of crude ore, is shipped by truck to the rail point at Elko, and thence by rail to the Tooele, Utah, smelter of the International Smelting & Refining Company, of which Mountain City is a subsidiary. J. J. Lillie is general manager.

▶ The International Smelting & Refining Company, Anaconda subsidiary with offices at Salt Lake City, has entered into an agreement with the Copper Canyon Mining Company, with extensive gold and copper properties in Lander County, under the terms of which International will equip and operate the Nevada properties, with option to purchase 2,000,000 shares of Copper Canyon stock at 25c. per share. Authorized capital of the latter is to be reduced from $700,000 to $500,00 in shares of 10c. par value, the owners of some 2,000,000 outstanding shares waiving the right to subscribe for additional shares at 25c. Upon receipt of waivers required, International will provide $500,000 for exploration, development, water supply, power plant, and a mill of such capacity as may be warranted by the volume of the reserve. A 1938 report by L. S. Breckon, of the Utah Copper Company, estimated the value of the reserve above a depth of 330 ft. at $6,000,000. A statement outlining terms of the agreement has been issued to shareholders by L. E. Whicher of 25 Broad St., New York, treasurer of the Copper Canyon Company.

▶ Nevada Keystone Mining Company, operating subsidiary of the Silver Burro Exploration Company, has opened a 6-ft. width of gold-silver ore in a short crosscut from a development drift. Diamond drilling is in progress from the surface and underground. The property is in the old Central district in northern Pershing County. Raymond Brooks, of Winnemucca, is in charge of operations. H. E. Linden is president of the Silver Burro Exploration Company of 7000 Romaine St., Hollywood, Calif.

▶ In the Eldorado Canyon district, in southern Clark County and in the southern point of the State near the Colorado River, the Wall Street Mines, restoring to production long-abandoned mine workings, have been operating for some time, with economic success, a 50-ton flotation mill that is said to obtain a 91 per cent gold recovery with ball mill, Denver jig, flotation and cleaner cells, and corduroy tabling. Ore is mined by the slusher method from a flat-lying deposit and 30 men are normally employed. W. W. Hartman, of Los Angeles, is the principal owner of a group of four old mines, and operations are directed by A. E. Place, manager, of Nelson, Nev.

▶ Scheelite deposits are being further prospected by diamond drilling on the St. Anthony mine of the Rare Metals Corporation, an affiliate of the Nevada-Massachusetts Company, Inc., largest United States producer of tungsten. The properties are in the Trinity range in Pershing County. Ott F. Heiser, of Lovelock, is general manager.

▶ At an elevation of 8,800 ft. above sea level, on the crest of Buckskin Mountain in northern Humboldt County, the newly-formed Buckskin Quicksilver Company has completed installation of a 100-ton Gould rotary furnace, after prolonged difficulties in transporting the 64-ft. unit up the steep and tortuous canyon road. The property was secured under option from Chalmers McCormick and John Dermody by Clarence H. Hall, field engineer for the United States Vanadium Corporation. Head of the company is St. John Whitney, of San Francisco, president of the Leslie Salt Company. Wendell C. Hammon, mining engineer of San Francisco, is consulting engineer and P. M. Anderson is superintendent, with office at Orovada.

▶ Grading has been in progress and a water supply is being developed for a 75-ton mill on property of the Gold Point Currant Creek Mines Company in the lately opened Currant Creek district in northeastern Nye County. John N. Richardson, of Ely, is manager.

▶ Heads of the Getchell Mine, Inc., were reported to have taken options and started surface work on a number of scheelite claims near Poverty Peak, some 15 miles west of the Getchell gold mine in Humboldt County. Fred Wise, superintendent for the Getchell Mine, Inc., receiving mail at Redhouse, Nev.

UTAH

Murray Lead Smelter Resumes Operations

Accumulation of lead concentrates sufficient for work until next spring—Leasing operations continue on curtailed basis

▶ The Murray plant of the American Smelting & Refining Company resumed operations on Aug. 14. Two hundred and fifty men were restored to the payroll by the resumption. Sufficient ore has been stockpiled, according to William J. O'Connor, general manager, to assure operation until spring.

▶ Leasing operations in Utah metal mines are still seriously affected by recent State Supreme Court decision holding that under the Federal Fair Labor Standards Act lessees are eligible for unemployment insurance. A recent ruling of Col. Phillip B. Fleming, administrator of the wage and hour division, United States Department of Labor, clarified the situation somewhat. The department has ruled that when the

lease agreement reserves supervision and control of mining operations for the lessor, it is not a bona fide lease, and the lessor is responsible for payment of wages and overtime as provided by the act. In properties like the Chief Consolidated mine, at Eureka, where the whole mine is turned over to lessees, operations have been resumed and employment is normal. But in the large number of mines where the owners lease blocks of ground to lessees but still control and work other parts of the property, leasing is at a standstill. Over 1,000 lessees are said to be affected by the ruling. However, negotiations are still under way for the purpose of meeting the new situation.

▶ Silver King Coalition Mines reports for the quarter ended June 30 a net profit of $101,978.56 after all taxes and depreciation, equal to 8.4c. per share. For the twelve months ending June 30, the company shows a net profit of $656,980.33.

▶ Officers of the of the Tintic Gold Mining Company announce that operations will be resumed at the Eureka property. Contractors are making steady progress in driving ahead the Gem tunnel to cut seven objective fissures in the Ophir-Midland property, Ophir Canyon, Tooele district.

▶ Operations have been resumed in the Wah Wah mine at the head of Pine Canyon, 53 miles southwest of Milford. The company is sinking its 125-ft. shaft to the 200 level to prospect a large body of sulphide silver-lead ore. If sufficient ore can be developed, the company plans to build a flotation plant. R. C. Dugdale, of Salt Lake City, is president and general manager.

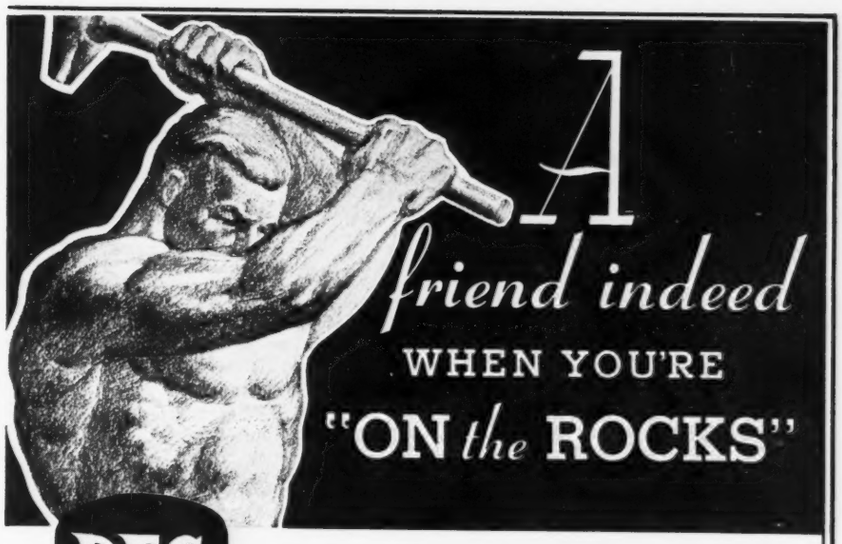
▶ The Mammoth Mining Company paid a 5c. dividend on July 30 amounting to $19,766 and bringing the total of disbursements up to $3,500,000. The company reports a net profit of $75,108 for 1939, compared with $40,364 in 1938.

The Tintic Wester Mining Company has resumed work at its West Tintic property on the 40 level.

▶ Park Utah consolidated Mines Company for the first half of 1940 reports a net income, before depletion and tax charges, of $177,033, compared with a net loss of $69,006 for the same period in 1939.

▶ Seventy men employed in the Elton Tunnel of the National Tunnel & Mines Company near Tooele returned to work when on Aug. 21 a two-year contract, effective July 1, 1940, was signed embodying substantially the same wages as those paid in the past, provided the price of copper does not fall below 10c. a pound.

▶ Utah's newest producer, the New Park Mining Company, had a net income, reports W. H. H. Cranmer, president and general manager, of Keetley, of $107,963 during the first half of 1940. This was before depletion and provision for federal income tax. A total of 18,572 wet tons of ore was shipped. Net income for July amounted to $16,363. The company plans to drive its Mayflower Tunnel, from which production is coming, a distance of at least 1,200 ft. more to cut other important fissures. The company has installed equipment to prospect its Gold Queen property.



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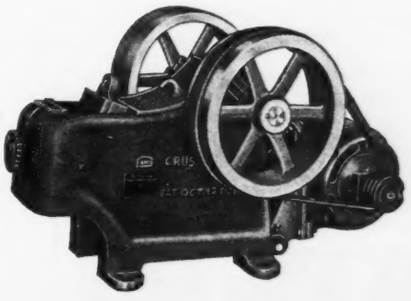

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COLORADO

Small Gold and Tungsten Plants Being Erected

Boulder County is scene of more activity —Alma Placer Company starts operations —Vanadium deposits to be prospected

▶ The Alma Placer Company, under the direction of Dan Ratliff, has started operations on the Rhodus placer, on upper Beaver Creek above the dredge at Fairplay. Leonard and McCoy are partners and have fourteen men employed on two shifts.

▶ Associated Originators, Inc., of Boulder, H. H. Nicholson, president, are building two plants for recovering gold and tungsten. This company was organized to design and build plants employing the Nicholson ore-treatment process. A 25-ton gold recovery plant is being built for Major J. Baker, of Boulder, and associates, near the Livingston mine, while the tungsten plant, of similar capacity, is being built for the Alloy Minerals, Inc.

▶ A vanadium boom has been noted in western Colorado, as the demand for alloy metals has caused several of the vanadium properties to open up, and mills are being rehabilitated. The United States Vanadium Corporation is buying custom ores.

▶ Wm. Reed, of the Montelores Mining Company, and his partner, M. V. Foglesong, of Phoenix, Ariz., have acquired rights to about seven hundred acres of ground along the Dolores River and on each side of the Montezuma-Dolores county line, for placer operations.

▶ The Kuenzel Smelter, Inc., announces that it has taken over the Carey Mining & Milling Company mill building at St. Elmo, and will install one of its furnaces to treat the lead, silver, gold, and zinc ores of the St. Elmo district and Park County mines.

ARIZONA

Non-Metallic Deposits Being Developed

Vermiculite and mica mines begin production—Mining property south of Tucson obtained by American Smelting & Refining Company

▶ C. H. Butler, who recently took over a vermiculite property 14 miles southeast of Kingman, in the Hualpai Mountains, has completed the road to the property and is installing a screening plant and expects to commence shipping the industrial product in September.

▶ The Mineral Products Company, of Phoenix, has installed a pilot plant of 3-ton hourly capacity on the Muscovite mine. The mica products is treated by a dry process and makes a product of 20 to 250 mesh. A test plant for wet-processing has also been installed which gives a product up to 500 mesh. C. L. Orem is managing the operations.

▶ The El Tire corporation has given a deed to the American Smelting and Refining Company for its properties in the Silverbell district south of Tucson. The purchase price is stated to be $10,000.

▶ The Gold Standard Mines, Inc., at Katherine, Mohave County, is running its mill at full capacity with ore from the Tyro mine. About 240 tons are being hauled daily by trucks for a distance of five miles. R. de Smet is general manager.

▶ The old 40-ton mill at Harrisburg is being remodeled. Both flotation and amalgamation are used in the flowsheet. A group of California men, E. M. Cregar, D. D. MacGregor, and Earl D. Wilcox, have taken over the property. George Dillard is directing operations.

▶ W. A. Garrison, working the American Nettie mine, in the Stockton Hill Section, 12 miles north of Kingman, recently found high-grade silver ore running around 1,000 oz. per ton, showing much wire silver. The property belongs to Mrs. George Pemberton and Thomas F. Grozier, of Kingman.

▶ The Gorham and Hall group of claims seven miles southeast of Superior is being cleared in the old workings preparatory to putting the gold-silver mine on a producing basis. Pat Gorham, of Superior, is owner of the property and has it leased to E. N. Perkins, also of Superior.

TRI-STATE

Volume of Tailings Re-treatment Increasing

Higher price for zinc concentrate encourages some operators to install equipment to treat lower-grade zinc tailings—American Zinc Company buys Evans-Wallower electrolytic zinc plant

▶ Production from tailings plant is being expanded to treat as much "thin" tailings as possible while a good market for zinc concentrates prevails. To retreat thinner tailings, the Western Mining & Milling Company recently installed additional equipment to double plant capacity near Cardin to 100 tons an hour. Two Denver No. 21 sub-A machines, with eight and nine cells respectively, were recently installed. H. H. Hartzell, of Baxter Springs, is superintendent.

▶ The American Zinc Company of Illinois, which is a wholly-owned subsidiary of the American Zinc, Lead & Smelting Company, has purchased from the Evans-Wallower Zinc Company its electrolytic zinc plant at Monsanto, Ill. Rehabilitation is under way and it is expected that the plant will start production early in 1941. The American Zinc Company expects to spend approximately $500,000 in rehabilitating the plant and will install additional roasting equipment at its Fairmont City, Ill., plant at a cost of about $300,000. Howard I. Young is president of the American Zinc, Lead & Smelting Company, with offices at Paul Brown Bldg., St. Louis.

▶ A mill, which will have a capacity of nearly 50 tons an hour, is being constructed by the Eagle-Picher Mining & Smelting Company on its Navy Bean lease, about four miles west of Wentworth, according to G. C. Niday, of Miami, Tri-State manager of company operations. Building materials and milling equipment from the old Commerce See Sah mill, south of Cardin, which was dismantled, will be used in the construction of the new plant.

▶ Operations have been resumed at the Hockerville mill of the Lula Bell Mining Company, following the completion of several months' of development work. Charles Barnett, of Joplin, president, is in charge of operations.

▶ Big Chief Tailing Company has been organized and is converting the Eagle-Picher Blue Goose mill, southwest of Cardin, one of the first modern concentration plants of all-steel construction built in the district, into an up-to-date plant for the re-treatment of tailings from the Blue Goose lease and others in the immediate vicinity. Kenneth Neal of Miami, is superintendent.

IRON COUNTRY

Greenway Iron Ore Mine Being Dewatered

Shipments are expected to start in September—New washing plant employing jigs completed at the Danube mine

▶ The Greenway mine, at Grand Rapids, Minn., is being dewatered, and E. A. Young, contractor, has cut a ditch to drain part of the pit water into the Prairie River and is cutting an approach and building a ramp to dump the pit ore into railroad cars.

▶ The Danube mine, at Bovey, Minn., (Pickands-Mather & Company) is now operating the new washing plant employing jigs which was recently completed.

▶ M. A. Hanna & Company have received a shipment of five new Euclid trucks of 15-ton capacity for use in the Mesaba-Chief mine at Keewatin, Minn.

▶ Consumption of Lake Superior iron ores is now running over 5,000,000 tons per month and shipments from the Lake Superior Docks are going forward at the rate of over 10,000,000 tons monthly. Shipments of iron ore will probably reach above 60,000,000 tons this year, and much depends upon the weather in regard to the total shipments. At the ore docks war-time precautions are being taken against sabotage and additional watchmen and policemen have been employed the last few months. Total shipments in August were 10,534,431 tons.

▶ The first diesel-electric locomotives for the Mesabi Iron range of the Lake Superior district went into service recently in the Minnesota properties of the Oliver Iron Mining Company. Of the ten diesel-electric locomotives going into service, seven are equipped with General Electric apparatus installed in locomotives built by the American Locomotive Company.

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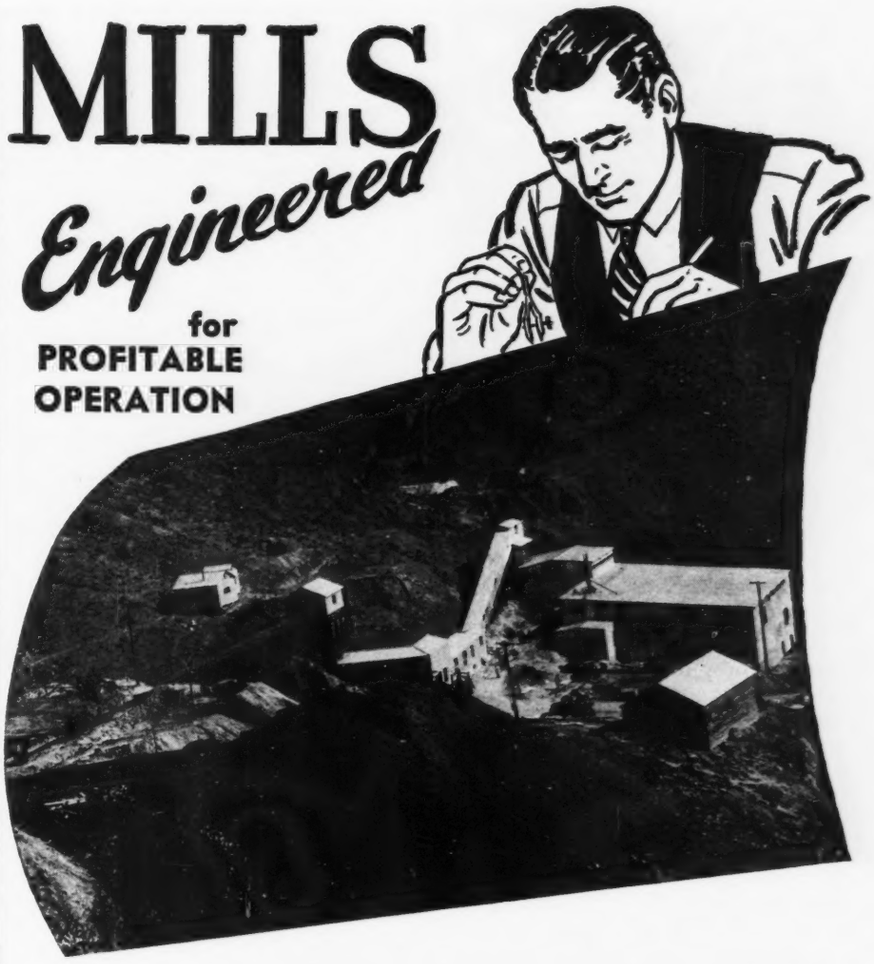

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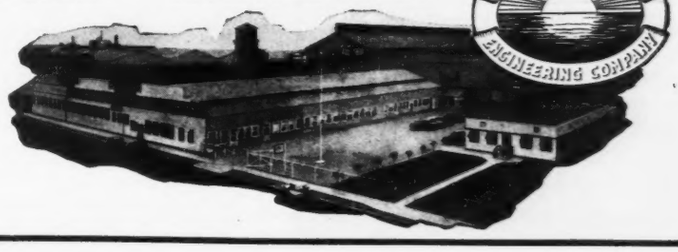

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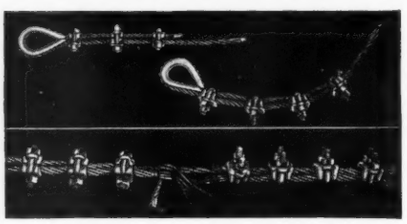

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WASHINGTON

Metaline and Grand View Mines Start Production

Zinc-lead deposits being exploited following extensive drilling program—Output expected to reach 1,500 tons of concentrates monthly

▶ The American Zinc, Lead & Smelting Company has announced the starting of operations of the Metaline & Grand View Mines at Metaline Falls, Wash. The Metaline Mine was put into production the week of Sept. 1, and the Grand View mine will start producing during the first half of September. Both properties will be operating at the capacity of the mill by the first of October, and will produce from 1,200 to 1,500 tons of zinc-lead concentrates per month. This will give employment to 160 men. D. I. Hayes is manager of operations for both companies, H. I. Young, of St. Louis, is president of the American Zinc, Lead & Smelting Company and president of the Metaline Company, and with W. N. Payne, secretary of American Zinc, and Mr. Hayes, H. Louis Schermerhorn, and W. B. Chandler, of Spokane, constitute the board of directors.

▶ Northwest Magnesite Company, at Chewelah, 50 miles north of Spokane, is shipping 200 tons of its calcined magnesite monthly to eastern steel plants, from which the demand is steadily increasing. The payroll has been increased and about 450 men are now employed. E. A. Garber is manager.

▶ Industrial Tungsten Corporation expects to be in production in September at its new mill, adjoining the well-known Germania tungsten mine, in southern Stevens County. J. E. McCloskey, engineer of Spokane, in charge, reports 2½ ft. of wolframite ore on the 200-ft. level.

▶ Harry Draper, of Spokane, president of Columbia Tungsten Company, 18 miles west of Addy, reports a vein 4 to 12 in. wide, carrying 15 per cent wolframite. This company acquired the property of Santa Fe Mining Company, giving the corporation fifteen claims.

▶ Western Molybdenum Company, owners of the Juno-Echo mine, near Chewelah, has installed a 120-hp. diesel engine to be used until the company can secure electric power. The ore is molybdenum and copper with some gold and silver, with the molybdenum increasing with depth. Ore is treated in a 150 ton Hardinge ball mill. J. J. Scherr, of Spokane, is manager.

▶ I. E. Bostwick, of Ione, and associates, have started development on their claims on Noisy Creek, in the Metaline mining district. The properties are reported to show commercial content of lead, zinc, and silver.

▶ Clear Creek Dredging Company, of California, is operating on Swauk River, on the Blewett Pass highway, in the Cascade Mountains of Washington, using a 2¼-cu.-yd. dragline bucket, advancing 50 ft. daily over a maximum width of 600 ft. along the river. The gravel is 8 to 20 ft. deep. D. W. Hinds, of Reeding, Cal., is manager and W. Frank Walthall, engineer in charge.

▶ Jay Dee Mining Company is installing a diamond drill, which is expected to explore the ground to a depth of 400 ft., near Chewelah. Values are silver and lead.

▶ Big Iron Mining Company, which was not in production last year, but at other times has shipped 3,000 to 5,000 tons of magnetite iron ore a year, is again shipping to Northwest Magnesite Company at Chewelah. The property is 10 miles from Rockcut, in northern Stevens County. The company is a private corporation with L. E. Jesseph, president; W. Lon Johnson, vice-president; H. Wade Bailey, secretary, and H. T. Wentz, treasurer, all of Colville, Wash. Shipments, to be acceptable, must run 85 per cent or higher in magnetite.

▶ Kaaba-Texas Mining Company, of Seattle, has put up a 200-ton mill, near Nighthawk, Okanogan County, and has ordered flotation, ball mill, and other machinery from the Union Iron Works, in Spokane. It has a 45-deg. shaft down 390 ft., with a 200-ft. drift on the No. 3 level and a 650 ft. drift on the No. 4 level. Drifts are in ore 6 to 12 ft. wide. The company expects to mill ore carrying $9 to the ton in silver and lead. E. C. Burns is in charge of operations.

OREGON

Bonanza Mines to Increase Quicksilver Output

Production of 500 flasks per month is objective—Bay Horse copper-silver mine reopened—Argonaut Gold Company plans construction of mill

▶ Bonanza Mines Company is installing a third furnace at its quicksilver property near Sutherlin, with which the company expects to produce 500 flasks of mercury a month. H. C. Wilmot is the engineer.

▶ Argonaut Gold Company expects to erect a 100-ton flotation plant to be ready before winter at its property, 13 miles north of Sumpter. High-grade ore will be shipped direct to the smelter. It is a gold property situated more than 7,000 ft. above sea level.

▶ United States Metals Company has reopened the Bay Horse Copper-silver mine, 10 miles north of Huntington, one of the best known producers in the State in previous years. Ore is said to be valued from $17 to $118 per ton. The company plans early construction of a mill. John L. Magney, of Spokane, is mining engineer and an official of the company.

▶ Sumpter Valley Dredging Company is running three shifts at its property, five miles from Sumpter. The company keeps $50,000 worth of supplies and equipment, including extra dynamos, on hand, which enable it to run twelve months a year. It reports that operating costs in exploiting the gravel have been reduced to less than five cents a yard.

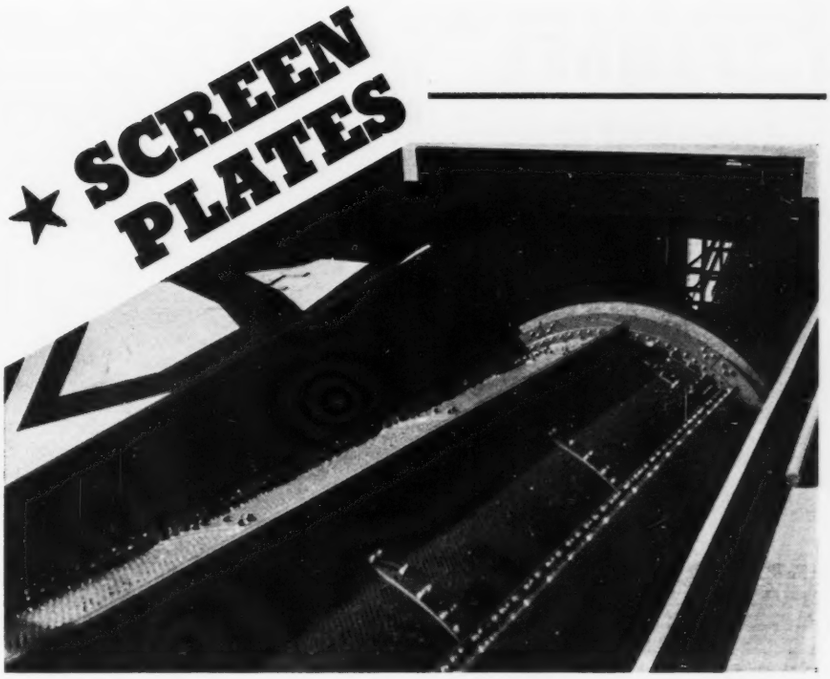
▶ Carson Channel Gold Syndicate reports average recovery of 26c. in gold per cu. yd., from 7,000 cu. yd. of gravel at its leased property, on the Grande Ronde River, in the northeastern part of the State. It is estimated that 30,000,000 cu. yd. of gravel is available for operations. E. J. Mimnaugh, of Spokane, is manager.

ALASKA

Callahan Zinc Starts Gold Operations

Production by Livengood Placers, Inc., was not expected until 1941—Tungsten deposits being prospected—Equipment to recover quicksilver sent to Alaska Quicksilver Company

▶ Initial operations of the first dredge of Livengood Placers, Inc., of which Callahan Zinc-Lead Company holds controlling interest, started Sept. 5, nine months ahead of first plans of the company. The dredge is a bucket type, 6 cu. ft. capacity, diesel-engine operated, made by the Yuba Manufacturing Company. Operations will be on a large tested area estimated to contain $16,000,000 in gold. A 3,000-ft. tunnel for water supply, is completed and hydraulic stripping operations on a



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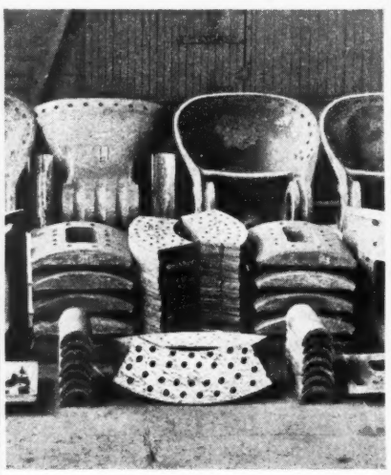

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▶ALASKA

small scale are now under way. These operations, however, are expected to increase during the next three years. Charles Lewis, at Livengood, Alaska, is in charge of operations.

▶ Alaska Quicksilver Company, Inc., has started equipment shipments to Bluff, for a 12- to 20-ton cinnabar plant on the property of E. M. Tucker and brothers.

▶ Arthur O. Moa reports that tests are being made of the tungsten ore found in the Riverside mine, near Ketchikan. He says fairly extensive deposits of scheelite have been found in this property, which was worked prior to 1930 for its lead-silver-gold values. J. H. Scott, of San Francisco, recently purchased the property.

▶ T. S. McDougal, manager and leaser of Fern Gold Mining Company, in the Willow Creek district, is having the site cleared for a new ball mill and other equipment, to increase plant capacity from 20 to 60 ton per day.

▶ Patrick Savage and Sam Bergstrom have taken over the lease, in the Circle Hot Springs district, formerly owned by William Shodde, Tom McKinnon, Peter Steiger, and Jack Boswell, who are said to have taken out $100,000 in two years. The new owners expect to add a 1½-yd. dragline.

▶ Goldfield Consolidated Mines recently flew in what is said to be the largest mining drill ever taken by plane into Alaska. It is a Keystone No. 70, which was taken by truck from Valdez to Chestochina, dismantled and flown 50 miles to the company's operations on Slate Creek. Goldfield company has taken an option on the property of Slate Creek Placers Company. D. C. Beyer is in charge.

▶ Grubstake Mining Company, a closed corporation organized at Anchorage, hopes to put the Thorpe gold property, in Grubstake Gulch, near Anchorage, in production this season. The property has a 14-ton mill, a jig and an amalgamator. Mike Zakula is president; Mike Novich, is vice-president; George Bennett, secretary, and G. E. Rockefeller, supervisor.

▶ United States Smelting Company, on Cripple Creek, near Fairbanks, is freezing some ground and thawing other ground. The freezing is done so that the banks of the dredge cut, which are 50 to 100 ft. high, will stand up. An ammonia freezing solution is forced into the ground. Freezing avoids the necessity of timbering and obviates cave-ins in the dredge cut. Thawing is a well-known operation which has been in use in Alaska for many years.

▶ Joseph T. Sullivan Company is using a 2-yd. slack-line scraper to raise gold-bearing gravel and sand from the ocean bed, near the shore line at Bluff, not far from Nome. The material is brought up from below the sea bed in a bucket and dumped on a 100-ft. spar tree on the beach. Forty years ago this beach was the scene of a great gold rush when the ground was so crowded with miners that each one was allowed only a few feet.

CANADA

War Threatens Shortage of Labor and Technicians

Military training being regulated so as to amplify labor supply—Buffalo Ankerite ready to start remodeled mill—Pioneer Gold Mines, in B. C., back to normal

▶ Loss of technical workers has been the first effect on mine staffs of Canada's aggressive defense program. Mechanics, chemists, metallurgists, and other special workers have been taken into government service to such an extent that some mine managements are badly handicapped. Though increases in operating costs are not yet serious, "War bonuses" are being paid in some cases and provision for large tax increases and a possible jump in wages has led to a cautious policy in regard to dividends. Military training is being regulated to avoid labor shortages in the mining camps, although the younger men have been enlisting in large numbers. Enlisted men are generally being replaced by older workers.

▶ In September the remodeled surface plant of Buffalo Ankerite Gold Mines will start operations. This will permit important savings and lead to enlarged development work at depth. More than $1,500,000 has been spent on the expansion project, including a new main shaft to open a block of levels from 1,000 ft. down to 2,300 ft. Large-scale mining at depth has been made possible by running a long connecting crosscut on the 2,000 level from the new shaft.

▶ Kirkland Lake Gold Mines, one of the twelve deepest mines in the world, has had no fatal accident since June, 1934, being relatively free of the rock bursts that hamper operations at the adjoining Lake Shore and Teck Hughes. Under the management of mine superintendent Harris, the property is said to be in the best physical condition of its long career. Work on the lower levels has extended the ore zone for more than half a mile along the "main break". Dr. J. B. Tyrrell is president.

▶ Pickle Crow Gold Mines, in the Patricia district, is starting to deepen the main shaft another 2,000 ft. Three new levels and a series of sublevels will be opened. In the shallower horizons grade of ore has been falling off, but a 50-ton increase to bring mill capacity up to 400 tons is expected to keep gold output at last year's record figure.

▶ J. W. McKenzie, mine manager of Bankfield Consolidated Mines, Little Long Lac area, reports favorable results on the bottom 1,275 level, and exploratory work continues to check promising values above. Walter H. Woods, consulting engineer, has laid out a program for exploring favorable ground along the strike of the North ore zone.

Quebec

▶ In the past year two increases in capacity have been made at the Montreal copper refinery of Noranda Mines, pro-

viding for an annual production of 112,000 tons of copper. At the mine a new converter is being added to the smelter, where an average of 350 tons of concentrates is being received daily from Aldermac, Normetal and Waite Amulet. Noranda is now deepening the new No. 6 internal shaft below the bottom 3,975-ft. level, with an ultimate objective of possibly 6,000 ft.

▶ Favorable results in opening three parallel veins in the No. 28 zone on the fourth level of Siscoe Gold Mines are reported by the president, J. B. Lynch. Diamond drilling from the long exploratory crosscut on the nineteenth level is being continued.

British Columbia

▶ Pioneer Gold Mines of B. C., Ltd., Bridge River area, which suffered an extended shutdown from October, 1939, to March of this year, because of C.I.O. union activity, has now returned its gold production to normal. Resumption of the usual milling rate of 350 to 375 tons per day was undertaken gradually.

▶ It is reported from the same area that Empire Mercury Mines, Ltd., is on production again, with fifteen men employed. The mine and 10-ton reduction plant closed down when mercury was priced at $60 per flask. The recent rise in the metal's value to approximately $180 per flask on the New York market has doubtless been responsible for renewed activity at the property.

▶ Privateer Mine, Ltd., Zeballos district, will not proceed with its option on the property of Proserpine Gold Mines, Ltd. The announcement was made by directors after receipt and consideration of the reports of A. M. Richmond, M. E., and W. V. Smitheringale, Ph. D.

▶ Because of engine trouble and short water necessitating a shutdown of 11 days, the July output of Central Zeballos Gold Mines, Ltd., was considerably down at $14,311, compared with approximately $25,000 in the previous month. A gasoline pump and some 1,100 ft. of pipe have been installed at the mine to prevent a recurrence of the water shortage.

▶ During July, the Utica mine in the Ainsworth district, about 18 miles above Kaslo, was reopened by Utica Mines, Ltd., of which D. M. Armstead, of Reno, Nev., is managing director. Operations are being conducted, for the present, through the fifth level, whence about 5,300 tons of ore averaging 131 oz. silver, 10 per cent lead, and 21 per cent zinc was shipped to the Trail Smelter prior to the last suspension of operations. Work is being financed by the Armstead Brothers, Colonel H. H. Armstead, of Vancouver, and D. M. Armstead. In due time, equipment, including another compressor, ore trucks, and other apparatus, will be considered. Operations are directed from the office at Kaslo, B. C.

▶ In presenting the annual report of Spud Valley Gold Mines, Ltd., Zeballos district, for the year ended May 31, 1940, P. F. Knight, president, announces that total ore reserves at the end of the company's fiscal year were estimated at 94,336 tons with an average god content of 0.319 oz. per ton.

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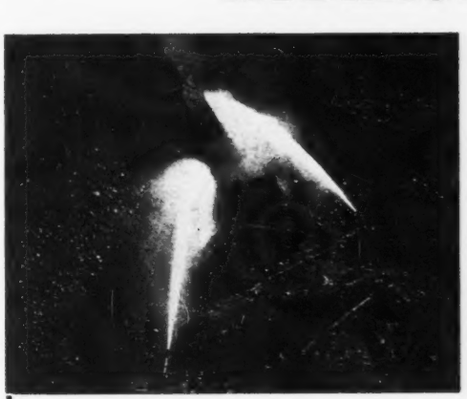

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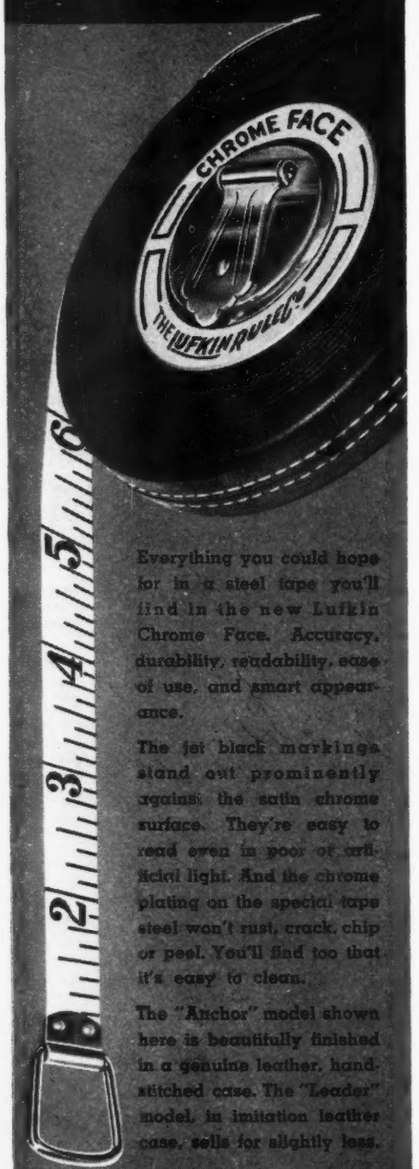

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MEXICO

Labor, Politics, and War Harass Mexican Mining

Strikes continue and foreign markets for lead and zinc are shut off because of war, but production must go on

▶ Mining shared the general uncertainty about the economic future and politics in Mexico that has become more acute with the advancement of summer. War is making things worse for the industry and the stronger peso is not proving to its advantage. However, some companies patched up labor troubles by giving in almost entirely to the workers. Gregorio Esparza, able and outspoken secretary-general of the national miners' union, has given up that position to devote his time to private affairs. It is believed that strife within the union was the reason for his resignation. Esparza is to be succeeded by A. Guzman, who is not well known for his conservative policies.

▶ War conditions are hitting mining hard, particularly the lead and zinc industry. Loss of important markets as Germany, Italy, France, Norway, Denmark, Holland, and Belgium, and decreased business with Sweden, account for the decline. In addition there is no relief in sight from high production costs and other taxes imposed by Mexican law.

▶ Cia. Minera de El Boleo, S. A., the last remaining French-owned mining company in Mexico, Santa Rosalia, Baja California, August Nopper, general manager, is not to become the property of the Mexican Government, the firm has announced in denying rumors to that effect.

▶ Cia. Peñoles has leased its mines at Ojuela, Durango, to its workers to conduct cooperatively. The lease was made when a Durango City business man quit working this property as he found it unprofitable. The miners believe they can profitably operate the mines, because they say there is still considerable ore remaining for exploration.

▶ Organization of an operating company for the Naica Mines of Mexico, S. A., Naica, Chihuahua, which have been run by a cooperative for some time, is planned by a syndicate of Naica businessmen. R. H. Sutton is serving as receiver and manager of these properties.

▶ Resumption of work at Mineral de Yoquivo, Campo municipality, Chihuahua, is being arranged by Cia. Minera Explotadora de Yoquivo, I. A. William Harding, general manager of San Francisco de Yoquivo, Chihuahua.

CUBA

Cuban-American Manganese Increases Plant Capacity

Metals Reserve Company signs contract with producer for acquiring from 25,000 to 65,000 tons of manganese ore during next three years

▶ Cuban-American Manganese Corporation, operating at Cristo, near Santiago, Cuba, is increasing capacity of its plant to produce ferro-grade ore from 100,000 tons a year to 130,000 tons, according to Langbourne M. Williams, Jr., president of Freeport Sulphur Company, of which the manganese corporation is a subsidiary. Cuban sources, it was pointed out, are close to the United States mainland, and, in effect, just as accessible as domestic sources of supply. The announcement of the expansion program revealed that the Metals Reserve Company, an R.F.C. agency formed to acquire strategic min-

Philippine Gold Production

Company	First Half 1940		First Half 1939	
	Tons, Ore	Value (Pesos)	Tonnage	Value (Pesos)
Antamok	91,547	1,266,590.08	133,639	1,942,500.68
Baguio Gold	70,760	1,077,923.00	57,075	942,361.04
Balatoc	365,764	6,622,776.76	306,347	6,199,818.39
Benguet Consol	230,915	5,430,149.17	204,707	5,705,420.43
Benguet Gold	14,523	320,186.08	.....	(a)
Big Wedge	39,878	967,079.00	38,335	934,624.08
Cal Horr	42,925	675,074.28	43,767	734,129.28
Capsay	19,180	650,036.30	.....	(b)
Coco Grove (c)	1,971,710	693,009.11	1,955.285	663,320.36
Crown Mines	1,813	57,376.00	.....	(b)
Demonstration	17,783	249,008.00	52,270	650,401.94
Gold Creek	5,421	90,654.17	.....	(a)
Ipo Gold	35,920	426,254.25	38,957	621,904.68
Itogon	163,576	2,577,082.26	171,280	2,174,626.49
I X L	72,096	1,531,974.64	82,337	1,534,693.23
Kilometer 73	8,493	144,513.42	.....	(d)
Macawiwili	16,105	260,647.77	15,584	216,741.64
Masbate Cons	510,773	3,077,700.22	461.123	2,167,090.87
Mindanao M. L	29,808	955,516.00	24,180	631,619.68
Mineral Res	13,284	166,481.59	4,309	64,287.63
No. Camarines	42,066	1,015,425.70	28,673	743,182.00
Paracale Gumuas	35,092	801,266.82	18,044	462,030.88
Paracale National	6,714	128,411.37	600	(e) 11,696.86
San Mauricio	87,358	3,137,723.25	61,957	3,224,169.67
Santa Rosa	27,431	379,042.00	30,695	527,898.65
Surigao	57,157	921,029.00	51,786	604,004.24
Suyoc	38,061	965,364.27	38,299	849,842.28
Treas. Island	23,418	546,403.78	11,407	312,094.20
Tuba	9,816	295,453.46	110,351	125,747.20
United Paracale	59,909	1,666,944.39	57,664	1,431,145.14
Totals	2,137,586	37,007,096.14	2,043,386	33,475,351.54

(a) Started milling December, 1939.
(b) Started milling November, 1939.
(c) Placer operation figures in cubic yards, not included in tonnage total.
(d) Started milling July, 1939.
(e) Started milling June, 1939.

erals, has contracted with Cuban-American for from 25,000 to 65,000 tons of ore annually for delivery during 1941, 1942, and 1943. At the Cuban property, ore averaging 20 per cent manganese is raised to 50 per cent or better through the company's flotation process. The original plant was completed in 1932, but the undertaking met with numerous obstacles, including metallurgical difficulties, an earthquake, three floods, and a revolution. Freeport Sulphur, according to the announcement, has invested more than $3,000,000 in producing ferro-grade manganese ore in Cuba, and until 1937, when production became economically and technically successful, the manganese company operated at a loss.

Copper Production in Chile Reduced

▶ Production of copper at the Chuquicamata mine, in Chile, was reduced 42 per cent during June this year, according to Mineral Trade Notes, issued by the Bureau of Mines. Production in May was 16,500 metric tons and in June about 10,000 tons. Production has also been cut at Potrerillos, but to what extent is not known. The principal market for the output of these mines was France.

Exports of copper from Chile during the first five months of 1939 and 1940, in metric tons:

	Jan.-May	
Electrolytic:	1939	1940
United States	1,042	81,024
Argentina	269	1,106
Belgium	16,270	.....
France	7,784	.....
Great Britain	13,770	432
Italy	7,982	6,120
Sweden	11,573	965
Other countries	1,090	1,200
Totals	59,690	90,847
Standard:		
United States	27,608	67,664
France	4,213	2,794
Germany	171	.....
Great Britain	23,386	.....
Italy	814	11,990
Sweden	2,747	1,093
Elsewhere	4,781	.....
Totals	63,720	83,541
Totals, all kinds	123,410	174,388

AFRICA

Belgian Congo Sends Metals to Britain

Copper and other resources are reported going to the British cause—Gold production continues to gain

▶ It seems that the production of Union Minière du Haut-Katanga is now to come to Great Britain, as the Belgian Congo Government has decided not to bow to Hitler. This production includes radium and cobalt with some 10,000 to 12,000 tons of copper per month. As the Belgian Congo proposes to stand shoulder to shoulder with Britain, its considerable tin and gold production will probably come to England also.

▶ British mining interests are not dismayed by the war. They are carrying forward their development, expansion, and construction plans, seemingly assured of victory. Financing is more

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ABOVE: Sludge is dug from settling pond with a SAUERMAN Scraper and hauled onto pile 800 ft. from pond.

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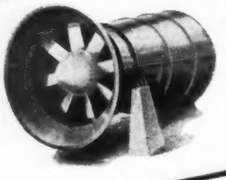

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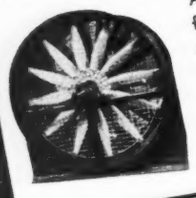

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▸AFRICA

difficult; that is all. For instance, the Federated Trust & Finance Corporation has secured a conditional option to purchase the mining properties of Nanwa Gold Mines, in the Ashanti, Gold Coast area, for £335,000. Nanwa has developed a mine, but it will require some £500,000 additional outlay to bring it to production. Federated Trust is ready to purchase the mine and then provide the needed capital. Though the price offered would pay off Nanwa's current indebtedness and return the capital at par, shareholders defeated the proposal to sell at a special meeting called for that purpose. The vote was by show of hands and a poll is now being taken. It is difficult to decide which is the more courageous, Federated Trust in making the offer or Nanwa shareholders in refusing it, as the price of the shares is below par. The Nanwa company was formed 38 years ago and is not yet a producer.

▶ Thistle-Etna Gold Mines (Southern Rhodesia) gave expression to its confidence in the future by the vigor with which it pushed development work last year. Ore reserves were increased by 17,000 tons to 90,230 tons, though 43,400 tons were treated. Both output and profit showed good increases.

▶ The June output of the Witwatersrand gold mines was 1,158,006 oz. and the profit £3,877,306. These results compare with 1,186,063 oz. and £3,933,060 in May, which were records. The one day less in June accounts for the decrease. Every effort is being made to increase output, as gold production is expected to help win the war.

▶ Western Holdings is continuing its large-scale exploratory activities in the Orange Free State, but four holes drilled the past month seem to have revealed negative results. These were in the area running up to the Vaal River which was recently taken under option. It was area it was thought well to explore, as there was a prospect of finding the Klerksdorp reef.

British Isles

▶ There is no likelihood of a shortage of tin in Britain, if sea routes are kept open. Production is in excess of the current demand and every consuming country in the world appears to be salvaging tin. Britain is recovering large amounts from discarded food tins. Polberro Tin, the most promising of the new developments in the Cornwall, England, district, has made further favorable discoveries in the south end of its workings. Matthew A. Francis, is consulting engineer.

Yugoslavia

▶ The report that the properties of Trepca Mines, Ltd., have been or will be confiscated is vigorously denied in Belgrade. Government commissioners are in charge, and because the war has cut off trade with Britain, the production

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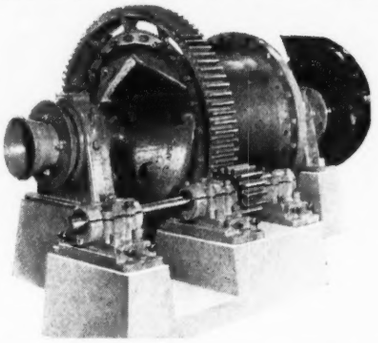

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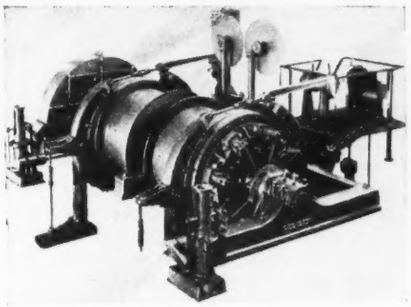
OTTUMWA

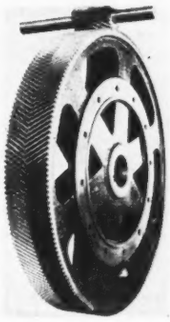


Ottumwa Hoists are built to meet every requirement of the mine operator, and to render efficient service with the minimum maintenance.

Ottumwa Hoists comprise a line which completely covers the requirements of coal and metal mines, from a 3 HP Room Hoist up to direct connected Hoists of 2000 HP or larger.

Engineers are always available for consultation. Put your hoisting problem up to Ottumwa.

Electric, Steam, Diesel & Gasoline Hoists.
Roller Bearing Trucks & Mine Cars.
Cages, Skips and Sheaves.
Herringbone and Spur Gears.



Ottumwa-Sykes continuous tooth herringbone gears give increased bearing surface and greater load carrying capacity.

Ottumwa is equipped to produce not only the Ottumwa-Sykes continuous tooth herringbone gears, but also generated straight tooth gears.

Ottumwa gears are made in all pitches from 16 D.P., to 1¼ D.P., and all sizes up to 123" diameter, 24" face.

In addition to a complete line of standard reduction units, we are prepared to build special units of all sizes.

OTTUMWA IRON WORKS

OTTUMWA, IOWA, U. S. A.

In continuous operation since 1867.

is presumably being sold to Germany and Italy. The same is said to be the case with the French-owned Bor copper property.

Spain

▶ Rio Tinto's report tells of a year of difficulties. Transition from war to peace in Spain was responsible for many of them, but shipments to Germany, previously the company's best customer, have been cut off completely since May a year ago. In consequence, total shipments of ore were only 820,000 tons, against 1,283,000 tons the year before. Investment income was down some £56,000, due to the smaller Rhokana dividend, but there was some gain through the adjustment of pesetas to pounds sterling. Net profit for the year was £139,000, against £148,200. The preference dividend which is being paid regularly calls for only £81,300.

AUSTRALIA

Gold Mining Is a "Reserved Occupation"

Declaration prevents loss of skilled men in the industry—Great Fitzroy copper-gold mine, in Queensland, to be reopened

▶ Gold mining has been declared a "reserved occupation" from which volunteers will not be accepted for war service abroad. This is in order to prevent the loss of skilled workers from the industry, with consequent risk of decrease in gold production.

Western Australia

▶ Performance of Central Norseman Gold Corporation, N. L., at Norseman, showed a great improvement during the year ended March 31, and the company recorded a net profit of £A201,301, compared with a loss of £A11,981 in the previous year. The main factors contributing to the improved result were the increase in the grade of ore treated and the enlargement in mill capacity, which is now 8,000 to 9,000 tons monthly.

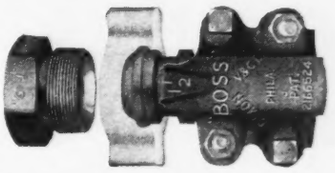
▶ The No. 30 (bottom) level at the Sons of Gwalia mine, Leonora, is opening up well and has already contributed appreciably to reserves. Ore reserves represent about six years' mill supply, and average 6.24 dwt. per short ton.

Victoria

▶ Deborah Gold Mines, N. L., Bendigo, is to reopen an old shaft, No. 2, to the south of its main shaft, and crosscut west to pick up the formation discovered in the South Deborah mine. Five head of stamps are being added to the mill. A new company, Deborah Extended, is being formed to open up ground lying to the south of the South Deborah.

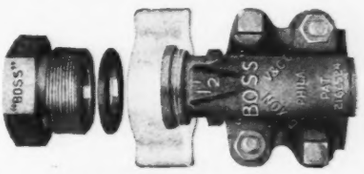
▶ To test a large low-grade gold property near Talbot, in the Maryborough mining district, Tunnel Hill, N. L., is being formed and will commence work soon. The lode is surrounded and partly intruded by slates, which are also auri-

What Does The Job Demand... GROUND JOINT or WASHER TYPE?



"GJ-BOSS" Ground Joint Type Style X-34 FEMALE HOSE COUPLING

When the service calls for hose couplings whose safety, efficiency and dependability can not be questioned, the "GJ-BOSS" is the answer! Washerless, leakproof, exceptionally strong and durable. Copper insert in spud fits accurately rounded head of steel stem, forming soft-to-hard metal seal that *will not leak*, regardless of wear. No service interruptions to replace lost or worn-out washers. No possibility of blow-offs, because of the powerful grip of the sturdy four-bolt "BOSS" Offset Interlocking Clamp. (On 1" and larger; two-bolt clamp, on ⅞" and smaller.) Cadmium plated—rust-proof.



"BOSS" Washer Type Style W-16 FEMALE HOSE COUPLING

Same as above, except that head of steel stem is flat flange to accommodate washer. All parts steel or malleable iron, cadmium plated to prevent rust. Sizes: ¼" to 4", inclusive, with 4-bolt "BOSS" Offset Interlocking Clamp on 1" and larger; 2-bolt clamp on ⅞" and smaller.

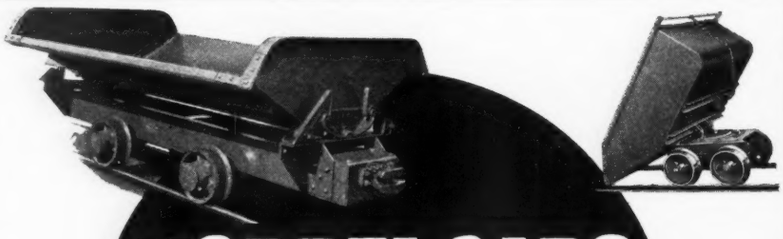
"BOSS" MALE COUPLING Style MX-16

The companion coupling for the "GJ-BOSS" and "BOSS" female couplings described above. Used in place of iron pipe nipples, it is much more practical and economical, as it eliminates the need of over-size hose. Cadmium plated—rust-proof. Sizes: ¼" to 4", inclusive, with 4-bolt "BOSS" Offset Interlocking Clamp on 1" and larger; 2-bolt clamp on ⅞" and smaller.

Stocked by leading rubber manufacturers and jobbers.

DIXON VALVE & COUPLING CO.

MAIN OFFICE AND FACTORY: PHILADELPHIA, PA.
Branches: Chicago—Birmingham—Los Angeles—Houston



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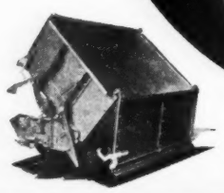
Can take it!



Tough! That's the best description of a Koppel Industrial Car.

Used throughout the industrial world, Koppel Cars have a proven record in the most gruelling service. Extra strength and extra durability are built into every detail of their design and construction.

Get acquainted with the broad choice available in the Koppel Car line—send for Bulletin No. 71 illustrating and briefly describing over 75 types of Koppel Cars for every conceivable material handling requirement.

PRESSED STEEL CAR COMPANY, INC.
(Koppel Division)
Koppers Building, Pittsburgh, Pa.

KOPPEL
U.S. PATENT OFFICE

For a SAFE, PROFITABLE INVESTMENT, choose-

Leahy HEAVY DUTY VIBRATING SCREEN

Capacity, Uniformity, Economy . . . are the "Big Three" of modern screening . . . and all are made maximum by the Tri-Vibe Type C No-Blind Vibrating Screen. This booster-feature *triple powers* the free-swinging screen jacket with the dynamic LEAHY differential vibration of the improved Heavy Duty Vibrator. By keeping the meshes clear, it increases capacity . . . by distributing the vibration . . . it maintains uniformity. Use this latest type LEAHY to reduce your costs of *fine screening!*

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THE ORIGINAL DEISTER CO.
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You can keep a Bucyrus-Erie bull-grader busy every minute of the day. Use it to build and maintain hauling roads, feed shovels, push hauling units, strip topsoil, clear out brush, and so on. It's a handy clean-up tool and leaves tractor drawbar free for hauling and other uses. For the complete story, see your nearest International TracTracTor Distributor.

Bucyrus-Erie Co.
SOUTH MILWAUKEE, WISCONSIN

▶AUSTRALIA

ferous, the gold being in a fine state and being largely recoverable by cyanidation.

Tasmania

▶A new company, Spartan Silver Lead Mines, N. L., has been formed to take over the property at Magnet, near Waratah, formerly worked by Magnet Silver Lead Mines, N. L. Operations are due to commence soon.

▶Wolber Valley Extraction Company has commenced production of wolfram concentrates at its mine at Moina. The plant for the production of tungsten powder at Heidelberg, near Melbourne, Victoria, has also been completed.

New South Wales

▶Wellington Alluvials, Ltd., Wellington, Macquarie River, handled 3,180,000 cu.yd. of material during the year to April 30, and recovered 14,825 oz. gold, an average of 2.24 grains per cubic yard.

▶During the quarter to March 31, Lake George Mines, Ltd., Captain's Flat, recorded an estimated operating profit of £A5275. Mill results were:

Operating costs amounted to 33.37 S. per ton milled. Lead concentrate is being sold in U. S. A. Production of pyrite concentrate will doubtless increase as and when markets are developed for this material. The ore contains a large percentage of the mineral.

Queensland

▶Plans are being laid to reopen the Great Fitzroy mine, near Rockhampton, which has been shut down for a considerable period. The mine was reckoned to be the second largest copper-gold mine in Queensland, being exceeded only by Mount Morgan. Present ore reserves are estimated at 530,000 tons, valued at 63/6 Aust. per ton. The operating company is Mount Chalmers, Ltd., and the ore is to be treated at Mount Morgan, initially at any rate.

▶Relinquishment of options held by Atlas Gold Mines, N. L., over low grade gold deposits at Kingston, South Queensland, is announced by one of the shareholding companies, Mount Coolon Gold Mines, N. L.

Fiji

▶Loloma (Fiji) Gold Mines, N. L., Tavua, has intersected the lode in the main crosscut at the bottom level (No. 5, 548 ft.) at 85 ft. east of the shaft. The crosscut was in lode for 11 ft., average assay being 7.5 dwt. per ton.

▶The general manager of Emperor Mines, Ltd., Tavua, reports that the new flotation and concentrate treatment plants are working well, and results to date are very satisfactory. The treatment of semi-oxidized and sulphide ores is, however, reducing mill tonnage somewhat. A new Symons crusher now being installed should permit increased throughput.

NEW BOOKS

THE PHOSPHATE RESOURCES OF TENNESSEE. *By Richard W. Smith and George I. Whitlatch. Bulletin 48. State Division of Geology, Nashville, Tenn. Pp. 444, 2 maps. Price $1.*

PREPARATION of this volume was undertaken by the senior author some years ago when he was attached to the staff of the Division of Geology as assistant geologist. After his departure for Atlanta, where he became State Geologist of Georgia, serving for some time in this capacity, the manuscript remained in the offices at Nashville, until it was taken in hand by Dr. Whitlatch and thoroughly revised so as to bring it to its present form. The bulletin is really a handbook on the Tennessee phosphate field. Not only does it give the results of the most recent geologic investigations made in the blue and brown phosphate fields, also discussing the theories as to the origin of the phosphate, but it describes the holdings, history, and mining and milling operations of the companies now in the area. The outstanding section of the report is the chapter on the phosphate reserves in Tennessee and the future of the industry. This is the work of Dr. Whitlatch.

A DICTIONARY OF METALS AND THEIR ALLOYS. *Edited by F. J. Camm, Chemical Publishing Company, New York. Pp. 245. Price $3.*

OF THE TOTAL NUMBER of pages, 187 are devoted to definitions of specific metals and alloys and related terms. For instance "zinc dust" and "zinc fume" are given as well as "zinc"; likewise "wrought iron" and "puddled steel" as well as "iron" and "steel"; also such terms as "hardness" and "heat-treatment." The characteristics of the metals listed are defined and, in the case of alloys, compositions are given. How complete the list is does not appear on cursory examination. It is essentially one for the "practical" man rather than the metallurgist.

MINES REGISTER, 1940, *Atlas Publishing Company, New York, N. Y. .Pp. 942. Price $25.*

THREE YEARS have intervened between the publication of Vol. 19 in 1937 and Vol. 20 in July 1940, making the appearance of the current volume doubly welcome and timely. The book has been improved and made more useful to the reader by a better arrangement of contents. Of greatest importance are those sections containing alphabetical descriptive references to 7,000 active mining companies in North, South, and Central America, and principal mining companies in foreign countries. Dormant or inactive companies to the number of 24,000 are listed separately. All lists are alphabetical. Among the features are: An alphabetical list of mining company officials; a list of mining and consulting engineers, managers, superintendents, and purchasing agents arranged alphabetically by States, provinces, and countries; metal industry statistics; metal mining security prices from 1931 to 1939; and an equipment and supply index and buyer's guide.

SILVER IN INDUSTRY. *Edited by Lawrence Addicks. Reinhold Publishing Company, 330 West 42d St., New York, Pp. 636. Price $10.*

IN ALL, the contributors to this volume are 28 in number, each of whom may be said to write with authority. The volume may be regarded as the culmination of the effort to "do something for silver," which objective led to the appointment of the committee that has been headed in the last few years by Mr. Addicks. To this objective generous support has been given by a group of the principal American silver producers, the National Bureau of Standards, and several Eastern universities. On one or two occasions the research work conducted by this committee has been summarized in the pages of the *Journal*. The volume which now makes its appearance contains some twenty chapters with an introduction by Mr. Addicks, by way of background. The topics of the chapters include the properties and technology of silver, the bonding of the metal at low temperatures and at high temperatures, and the use of the metal in bearings and for coatings, the latter including electroplated, chemical, and vaporized. Other chapters are devoted to the various alloys containing silver, to the use of the metal in electrical contacts, both stationary and moving; to the use of silver as a catalyst; the corrosion resistance of the metal and its alloys; the oligodynamic effect of silver; and silver as a fungicide. In addition statistics of consumption and miscellaneous other information that will be found useful are appended.

▼ ▼ ▼

PUBLICATIONS

RECEIVED

Geophysical Prospecting for Oil. By L. L. Nettleton, geophysicist, Gulf Research & Development Company, and advisory professor of physics, University of Pittsburgh. This is a connected presentation in a single volume of the principles and practice of modern oil prospecting by geophysical methods. Part I deals with gravitational methods, Part II with the magnetic method, Part III with seismic methods, Part IV with electrical and miscellaneous methods and measurements in drill holes. Part V deals with geophysical interpretation. Published by McGraw-Hill Book Company, 330 West 42d St., New York. Pp. 444. Price $5.

The Story of Superfinish. By Arthur M. Swigert, Jr., director of production research, Chrysler Division, Chrysler Corporation, Detroit, Mich. The author says he has sought to develop his theme from elementary principles in order to present clearly the most advanced technical information, this because there was no book devoted to the aspects and applications of the finish of metallic surfaces. The book has 21 chapters and 678 pages. Published by Lynn Publishing Company, Detroit, Mich. Price $5.

Financial Survey of American Mining Corporations. Supplement No. 2 of "Survey of American Listed Corporations," a W.P.A. study sponsored by the Securities and Exchange Commission. Contains financial data on 79 non-ferrous mining, smelting, refining, and fabricating companies with assets of over $20,000,000 each. Obtainable without charge from Publication Unit of Securities and Exchange Commission, Washington, D. C.

Colorado Bureau of Mines. Annual report of Commissioner of Mines for 1939. Denver, Colo.

Employment and Income from Gold Placering by Hand Methods, 1935-1937. National Research Project in cooperation with U. S. Bureau of Mines. Pp. 142.

U. S. Bureau of Mines, Washington, D. C., has issued the following Information Circulars and Reports of Investigations (no charge is made):

Information Circular 6751R (revision of I. C. 6751, Dec. 1933), Onyx Marble and Travertine, pp. 11. Also I. C. 7119, Mining and Milling Methods and Costs at Ash Peak Mine of Veta Mines, Inc., Duncan, Ariz., pp. 26. Also I. C. 7121, Minerals Used in Welding, pp. 56. Also, I. C. 7122, Novel Device for Collecting Air Samples in Inaccessible Places, pp. 4. Also, I. C. 7123, Mining and Milling Methods and Costs at Knob Hill Mine, Republic, Wash., pp. 29. Also I. C. 7125, Possibilities of Manganese Production at Leadville, Colo., pp. 23. Also I. C. 7127, Portable Cabinets for Materials Used in Mineral Determinations, pp. 6. Also I. C. 7128, Construction of Bingham-Copperfield Vehicular Tunnel, pp. 12. Also I. C. 7129, Petrographic Methods and Their Application to Examination of Non-metallic Materials, pp. 15. Also Report of Investigations 3509, Stemming in Metal Mines, Progress Report 1, pp. 37. Also R. I., 3515, Ore-Testing Studies, Primarily Precious Methods, pp. 76. Also, R. I. 3520, Quantitative Analysis by X-Ray Diffraction (Determination of Quartz), pp. 10. Also R. I. 3521, Measurement of Pressures on Rock Pillars in Underground Mines, Part II, pp. 11. Also R. I. 3522, Staining of Clay Minerals as Rapid Means of Identification in Natural and Beneficiated Products, pp. 21. Also R. I. 3523, Differential Grinding of Alabama Iron Ores for Gravity Concentration, pp. 6. Also R. I. 3525, Beneficiation of Boron Minerals, pp. 18.

U. S. Geological Survey has issued the following (for sale by Superintendent of Documents, Washington, D. C., at stated price): Bulletin 922-C, Manganese Deposits in the Little Florida Mountains, New Mexico, pp. 55-73 inclusive, plus maps, price 25c. Also, Bulletin 922-A, Quicksilver Deposits of Bottle Creek District, Humboldt County, Nevada, pp. 29, price 35c.

Gold Mining and Gold Deposits in New Mexico. Circular 5, State Bureau of Mines and Mineral Resources, Socorro, N. M., pp. 24.

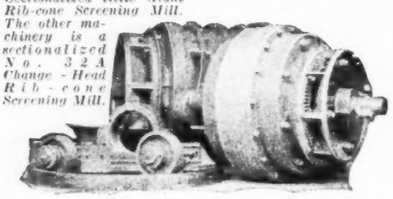
Dominion Bureau of Statistics, Ottawa, has issued the following at the respective prices stated: Salt Industry in Canada, 1939, pp. 10, price 25c. Also Summary Review of Gold Mining Industry in Canada, 1939, pp. 65, plus text of Excess Profits Tax Act, 1940, price 50c. Also, Feldspar and Quartz Mining Industry in Canada, 1939, including data on Nepheline-Syenite, pp. 12. Also, Mica Industry in Canada, 1939, pp. 11. Also, Miscellaneous Metals in Canada, 1939, pp. 36.

British Columbia. Annual Report (1939) of Minister of Mines, Victoria, B. C., pp. 163.

A Complete Mining Plant
Wrapped in Mattresses Dropped from an Airplane

An entire Rib-cone plant delivered by airplane to a mine 5000 feet above sea level. Crushers, feeders, amalgamation plates, tables, Rib-cone Ball Mill, ball charge and a diesel engine all wrapped in mattresses and dropped by parachute because there was no landing field. Straub, all-steel sectionalized machinery made this unusual feat possible. No matter where your mine is located . . . no matter what type of equipment you need, Straub sectionalized equipment can be quickly and economically transported "anywhere a Mule Can go."

Sectionalized little Giant Rib-cone Screening Mill. The other machinery is a sectionalized No. 324 Change-Head Rib-cone Screening Mill.



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STRAUB SECTIONALIZED EQUIPMENT
is installed in the field by inexperienced labor

Straub Sectionalized machinery comes to you in sections, but, before it leaves the shop it is completely assembled and each part clearly marked for easy assembly in the field. Light-weight, all steel construction, bigger bearings, patented spiral type ball lifters in Straub Rib-cone Ball Mills give the same high-capacity, low cost recovery whether sectionalized or not. Sectionalized mills are available in a wide range of sizes and types to fit your exact needs. Write for information . . . give us complete details of your problem; size of grinding mesh, capacity, power, treatment, etc. Straub welcomes the opportunity to help you . . . there's no obligation.

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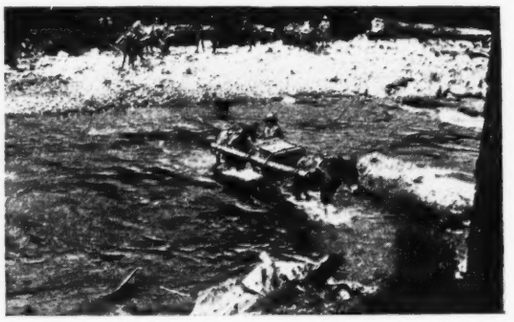

Part of a 50 ton plant . . . all transported by mule back and installed by unskilled labor.

The loss of weight of a shaft sleeve from wear may be measured in ounces. Without this metal, however, the entire shaft sleeve is only scrap. Hence the value of metal destroyed by packing friction is worth hundreds of dollars per pound. PALCO PACKING prevents this wear on water pump plungers and shafts. Especially recommended for high speed centrifugals. PALCO is self-lubricating and effects a tight seal without creating undue friction.

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PRE-COAT *Clarification* PRECIPITATION

MERCO

The Merrill-Crowe Precipitation Process with Pre-Coat Clarification is now almost universally used in cyanide plants throughout the world. Every operator appreciates the advantages of the complete and efficient clean-up of the Merrill-Crowe Process as a means of checking bullion production against ore and solution assays. Descriptive bulletin will be mailed on request.

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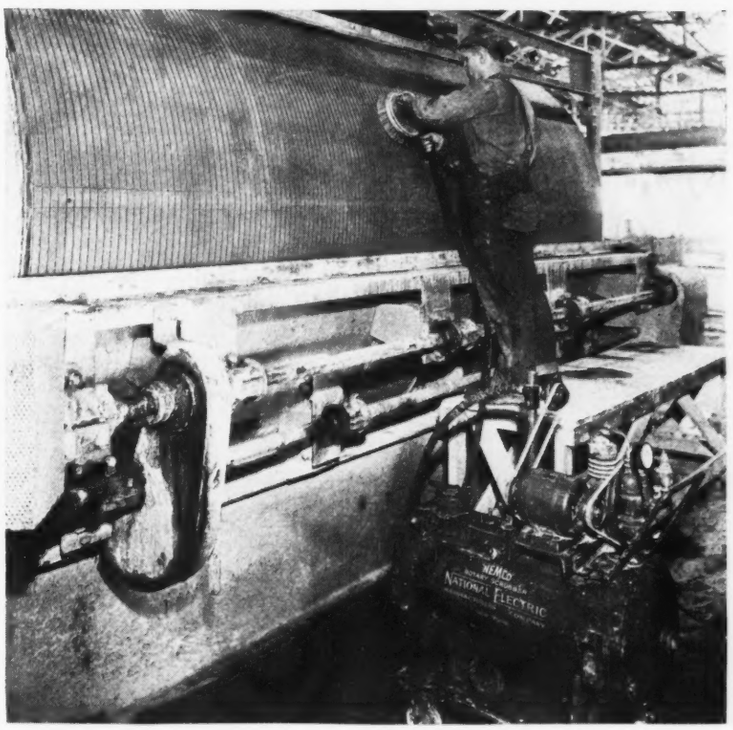
MERRILL-CROWE

EQUIPMENT NEWS

Cleaning Filter Drums



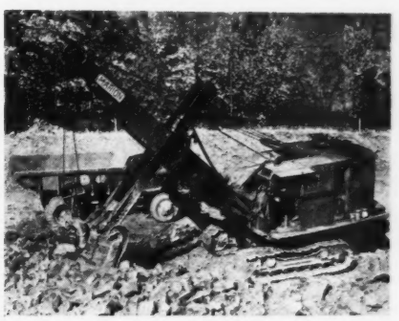
A SELF-CONTAINED UNIT, operating from an ordinary light circuit to clean filter drums, is announced by the National Electric Manufacturers Company, 60 East 42nd St., New York, N. Y. Known as a power rotary scrubber, it is said, one man can scrub and treat a 10x20 ft. drum-type filter in 20 to 30 minutes from the time the filter is cut out and put back into service. It is self-contained, portable, and easy to operate. The cleaning solution containing a proportional amount of acid is poured and mixed in the 20-gal. tank. The ¾-hp. motor builds up the pressure to gage and is said to maintain a constant pressure in the tank. Solution is forced through a rubber tube connection with the axis of the rotating brush, the flow or rate of feed being controlled by a valve at the brush. The rotating brush is held against the cloth while the drum is revolving at the regular speed. The acid solution flows through the axis of the brush at a fixed rate and is evenly spread over the surface of the cloth by the action of the brush. Disc-type filters can be cleaned by removing and placing upon a rack where they can be rapidly scrubbed.

A new printing unit known as the Model F whiteprint machine that is said to offer a fast, economical, convenient and efficient method of making positive-type reproductions of engineering drawings, letters, charts, etc., is announced by the Ozalid Corporation, Johnson City, N. Y. It is claimed this machine has a printing speed up to a maximum of 56 inches per minute

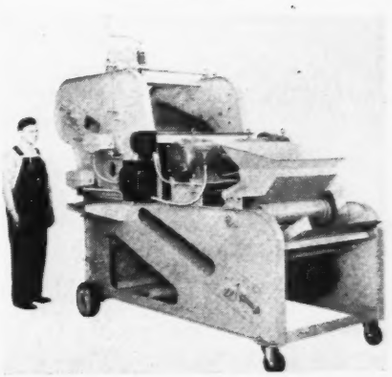
Magnification and light are quickly available in the device shown above introduced by the Boyer-Campbell Company, Detroit. Known as the Super Sight it is equipped with a mounting clamp for quick attachment to a chair

Hook-on Volt-Ammeter

A VERSATILE, portable instrument, the Type AK-1 hook-on volt-ammeter, for measuring alternating current and voltage, has been introduced by the General Electric Company. With it, alternating current can be read instantaneously on both insulated and non-insulated conductors simply by hooking the instrument around the line. For voltage readings, it is necessary only to connect two leads furnished with the instrument and then flip the thumb-manipulated selector switch to the desired voltage position on the scale. Weighing only 3½ lb. it is designed for easy, one-hand operation. Four current ranges, 0-15-60-150-600 amperes, and two voltage ranges, 0-150-600 volts, are available at the setting of a convenient six-position snap switch.



The Marion Steam Shovel Company, Marion, Ohio, announces its improved Type 372—1¾-cu.yd. shovel. This unit is equipped with a vacuum control dipper trip which is controlled by a single lever at the operator's station.



Combining two magnetic separator units in one machine for the purpose of providing effective separation of brass and iron turnings in industrial plants is announced by the Sterns Magnetic Manufacturing Co., Milwaukee

Welding Rod

THE AMERICAN MANGANESE Steel Division of the American Brake Shoe & Foundry Company, 389 East 14th St., Chicago Heights, Ill., has introduced Amsco Mo-Mang welding rod, described as a low-cost manganese-molybdenum steel welding rod for building up worn high manganese, carbon steel, and grey iron castings. It is available in 18-in. lengths in the bare form for straight d.c. welding and in the combination coated form for both d.c. and a.c. applications.

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EQUIPMENT

FOR

SMALL OPERATIONS

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PAN-AMERICAN JIGS—Savings made on riffle tailing losses in many cases have fully paid for Pan-American Jig installations in twelve months or less. . . Sturdy, trouble-free performance.

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KRAUT FLOTATION MACHINES—Ideal for small operations. High metallurgical capacity combined with small floor area and low head room.

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PAN-AMERICAN JIGS—For various mill products.

Send for Bulletin PME.

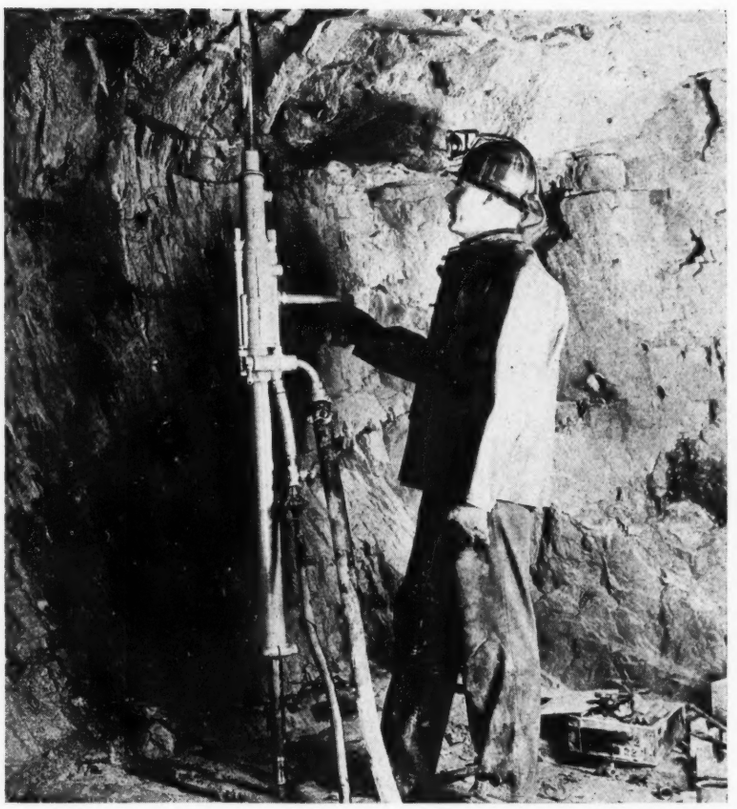
Send us brief details of your operations and let us suggest how Pan-American equipment may help effect savings in your operations.

PAN-AMERICAN ENGINEERING CO.

820 Parker St., Berkeley, Cal., U.S.A.

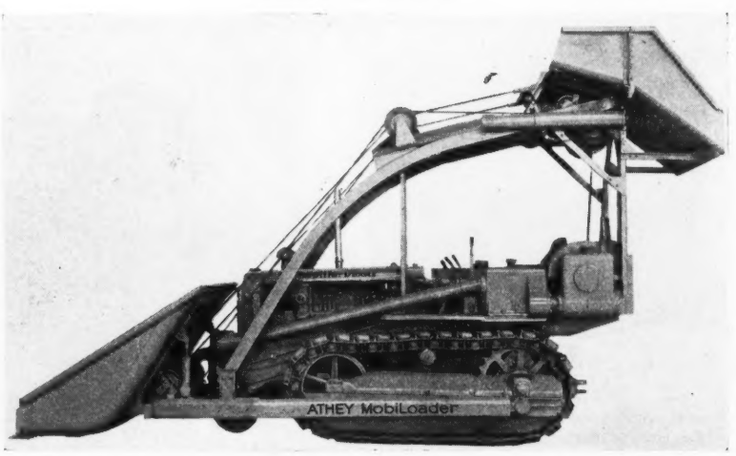
Design, Metallurgical Testing and Field Consulting Service; Manufacturers of Mill and Placer Recovery Equipment.

New Lightweight Stoper



A SELF-ROTATING STOPER weighing 96 lb. and equipped with new and improved features is announced by the Sullivan Machinery Company, Michigan City, Ind. Known as the Sullivan Class S91 and drilling 2 ⅞-in. holes, this light stoper offers simple operation for the miner and has a new dual valve that controls admission and cut-off of air to either end of the piston independently. It is said to provide a greater force of blow (by preventing premature admission of live air ahead of the piston), powerful rotation, and improved efficiency. Other advantages listed by the manufacturer are shake-proof throttle handle; non-leak feed cylinder joint; replaceable buffer-ring bushing; alloy-steel feed cylinder; long-life feed-valve design, and improved rotating handle.

New Fast Loader



DESIGNED FOR DIGGING and dumping without maneuvering or turning and permitting free oscillation of the tractor tracks, the Athey Truss Wheel Company, 5631 West 65th St., Chicago, Ill., announces its new unit called the Mobiloader for use on D4 and R4 Caterpillar tractors. The loading device can be mounted on the tractor in the field and if the tractor is desired for other purposes, the bucket and bucket yoke may be detached by removing two pins and disconnecting the cable, or bucket alone, by removing four pins. Bucket capacity

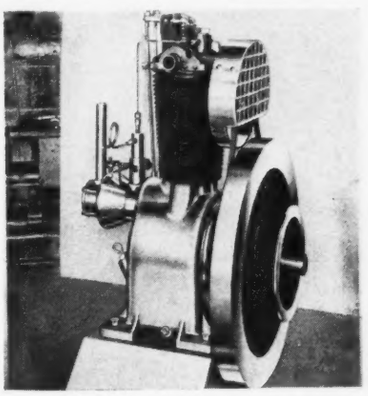
is 1½ cu. yd. and loading cycle is said to be 15 sec. At the front of the machine is a roller that relieves the equalizer spring during digging and loading operations, thereby eliminating the

necessity for rigid tracks. Stability and balance are said to be controlled by transferring center of gravity by movement of loaded bucket through the lifting arc. The over-all height of the unit with bucket raised is 15 ft. 7 in. and the over-all length with bucket lowered is 19 ft. 6 in.

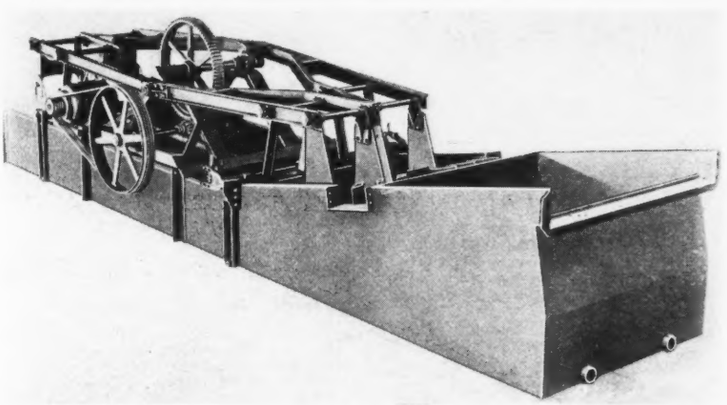
The manufacturer states the digging unit is mounted on the bulldozer principle that takes advantage of the pushing action of a tractor and employs the power-shovel principle of "arc" digging to provide the shortest swing for the fastest loading.

Light-Weight Diesel Engine

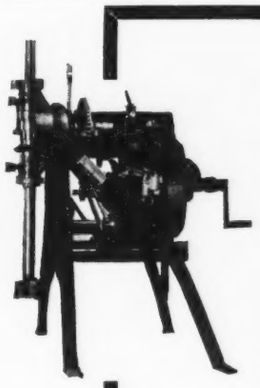
W. W. GIBSON, 1801 Webster St., Alameda, Calif., announces a new small, light-weight diesel engine, known as the Gibson diesel. The manufacturer claims that compact design, sturdy construction, and a novel air-cooling system assure dependable operations both in adverse climates and high altitudes; low maintenance costs; and low fuel consumption. The new unit can be adapted



to a wide field, and is suitable for operating mining and milling machinery, lighting plants, pumps, farm and contractors equipment, and others. It is a



A simplified mechanism requiring no cams or rollers for operating their line of classifiers is announced by the Morse Bros. Machinery Company, P. O. Box 1708, Denver, Colo. The mechanism for actuating the rakes consists of heavy, fully welded, channel-iron drive arms, cast-iron rocker arms, and a heavy plate member attached rigidly to the classifier rakes. The extreme ends of the drive arms are said to move in a downward and upward plane in unison at the starting and termination of each stroke of the rakes



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USE NAYLOR LIGHT WEIGHT PIPE instead of costlier heavy pipe. It's ideal for pressure lines, thanks to its exclusive Lockseam Spiralweld which makes it leak-tight, stronger, more flexible and SAFER than ordinary light-weight pipe. Sizes from 4" to 30" in diameter. All type fittings and connections.

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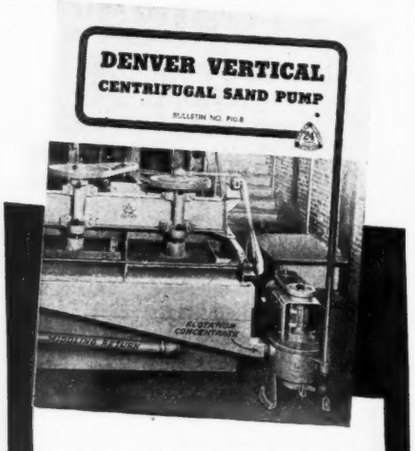
NAYLOR LOCKSEAM SPIRALWELD PIPE



This NEW BULLETIN No. P10-B on the Denver Vertical Centrifugal Sand Pump will help you solve the handling of troublesome pulps without dilution or operating attention. This pump will handle all material which can be made to flow by gravity to the feed opening—sticky flotation froth, gravity concentrates, deslimed pulps, unit flotation cell concentrates, amalgam barrel tailings, jig hutch products, etc.

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four-cycle, solid injection, full-diesel type, and is built in two sizes—5 and 10 hp. Where transportation difficulties are encountered, power up to 120 hp. can be developed by operating units of 10-hp. Gibson diesels in tandem through a special line shaft arrangement and V-belts. The V-drive pulley is cast to the machined flywheel, and is twin belted.

BULLETINS

Cable Connections. Mines Equipment Co., 1909 South Kingshighway, St. Louis, Mo. Bulletin Mc-106 describes and illustrates the company's rubber cable connectors for mine and industrial use. Pp. 14. **Electric Track Switch.** Bulletin ES-103 describes and illustrates a device to throw mine haulage switches electrically. Pp. 8. **Rubber Cable Vulcanizer.** Bulletin RV-104 describes a vulcanizing device for rubber cables. Pp. 8.

Industrial Lubricants. Standard Oil Co. of N. J., 26 Broadway, New York, N. Y. Bulletin describes numerous industrial oils and their application. Pp. 24. **Diesel Fuels.** Bulletin describes oils for diesel engines. Pp. 24. **Air Tool Lubricant.** D-239-A-1 folder describes oil rock drills. Pp. 2.

Metal Spring Gun. Master Metal Spring, Inc., 2527 Magnolia St., Oakland, Calif. Bulletin describes and illustrates the manufacturer's new metal spray gun for building up worn machine parts. Pp. 4.

Slushing Scrapers. Alloy Steel & Metals Co., 1862 E. 55 St., Los Angeles, Calif. Bulletin 95 illustrates and announces improvements to the manufacturer's all-manganese steel scrapers for underground operations. Pp. 8.

Car Loader. The Eimco Corp., Salt Lake City, Utah. Bulletin 104 describes and illustrates the manufacturer's new Model 12-B and No. 21 Eimco-Finlay loader. Pp. 4.

Roasters. Bethlehem Foundry & Machine Co., Bethlehem, Pa. The company offers a handsome brochure that describes and illustrates the company's equipment for the process industries. One section is devoted to the Bethlehem Wedge type roaster, describing its operation and construction. Pp. 40.

Guide to Nickel Alloys. International Nickel Co., Inc., 67 Wall St., New York, N. Y. Pocket size booklet devoted to uses and properties of seven metals. Pp. 16.

Generator and Exciters. General Electric Co., Schenectady, N. Y. GEA-1607 C contains information on Type B generators and exciters. Pp. 4. **Synchronous Motors.** GEA-3375 describes advantages of the manufacturer's synchronous motors and control for part winding starting. Pp. 4. **Induction Motors.** GEA-1412 B describes and illustrates features of the GE vertical solid-shaft and advantages of vertical hollow-shaft induction motors. Pp. 4. **Vertical Motors.** GEA-3223 describes the company's type KC single-phase vertical motors for centrifugal and turbine pumps. Pp. 12. **Immersion Heaters.** GEA-214 D describes and illustrates sizes of the GE Calrod immersion heaters for use in heating liquids in tanks, kettles, or metal barrels. Pp. 4. **Prevention of Weld Spotter.** GEA-3198 A describes the use of Glyptal 1294 to prevent adhesion of weld spotter. Pp. 2.

Protective Products. Willson Products, Inc., Reading, Pa. The general catalog of the manufacturers' products for industrial safety is well illustrated and description covers products from abrasive blasting helmets to wire screen goggles. Pp. 40.

Meehanite Castings. Meehanite Metal Corporation, Pittsburgh, Pa. Form 100 describes large pump castings made of Meehanite metal. Pp. 7.

Sick Absenteeism in Industry. Air Hygiene Foundation of America Inc., Pittsburgh, Pa. Medical Series Bulletin 4 is a symposium on sick absenteeism in industry, its extent, causes, and control. Pp. 29. Price 25¢.

Wire Rope Clips. Thomas Laughlin Co., Portland, Maine. Folder describes and illustrates features of the manufacturer's new wire-rope clips. Pp. 4.

Insulated Clevis Assemblies. Ohio Brass Co., Mansfield, Ohio. Bulletin 688-H describes the manufacturer's three sizes of spools, including one for standard secondary rack use and four types of insulated clevis assemblies using these spools. Pp. 4.

Bottom-Discharge Trailers. Sanford-Day Iron Works, Inc., Knoxville, Tenn. Form 1255-K describes the manufacturer's automatic bottom-discharge trailers. Pp. 4.

General Catalog. Jeffrey Mfg. Co., Columbus, Ohio. Booklet 733, is a pocket edition entitled "What We Make." It covers the manufacturer's line of chains, crushers, vibrating screens, and other mining and industrial equipment. Pp. 32.

Cyanide Mill Machinery. Morse Bros., Denver, Colo. Bulletin C-40 describes and illustrates equipment made by the manufacturers for use in cyanide plants. Pp. 8. **Filters.** Bulletin 910, describes and illustrates the company's continuous drum and disk filters. Pp. 8.

V-Type Pump. The Dorr Co., 570 Lexington Ave., New York, N. Y. Bulletin 5001 describes the manufacturer's new and improved type of diaphragm sludge pump. Pp. 6. The company also announce an attractive pictorial review of its manufacturing plant facilities. Pp. 12.

Small Valves. Crane Co., Chicago. Bulletin AD 1420 describes and illustrates the company's complete line of small steel valves.

Screens. Nordberg Mfg. Co., Milwaukee, Wis. Bulletin 96 describes and illustrates the manufacturer's Symons screens featuring the reciprocating action.

Timber Jack. Templeton, Kenly & Co., 1020 South Central Ave., Chicago, Ill. Form 40 describes the features of the company's new Simplex mine timber jack. P. 1.

Gravel-Washing Plant. Smith Engineering Works, Milwaukee, Wis. The company offers an informative booklet on gravel washing plant layouts. Pp. 19.

Sump Pump Motor. General Electric Co., Schenectady, N. Y. GEA-3352 describes the company's fractional horsepower sump-pump motor. Pp. 2.

Ice Maker. Carrier Corporation, Syracuse, N. Y. Form 13E-S-1E describes the manufacturer's line of electric bulk ice makers with capacities from 75 lb. to one ton of ice per day. Pp. 2.

Rigger's Handbook. Broderick & Bascom Rope Co., St. Louis, Mo. The company offers its latest publication on wire-rope slings, fittings, socketing, splicing, and engineering data covering uses of wire rope. Pp. 96.

Thermocouples. Wheelco Instrument Co., 1929-1933 So. Halsted St., Chicago, Ill. Bulletin S-2-2 illustrates and describes the company's line of thermocouples, thermocouple wire, lead wire, and protecting tubes. Pp. 15.

Tachometers. James G. Biddle Co., 1211-13 Arch St., Philadelphia, Pa. Bulletin 1650 describes and illustrates instruments for measuring speed, frequency, and rates of vibration. Pp. 4.

Electric Assay Furnaces. The Denver Fire Clay Co., P. O. Box 5510, Denver, Colo. Bulletin 440 describes operating details and illustrates the company's new line of electric assay furnaces. Pp. 6.

Winches. Stephens-Adamson Mfg. Co., Aurora, Ill. Bulletin 340 describes and illustrates the manufacturer's line of hand and motor winches. Pp. 4. **Box Car Loaders.** Bulletin 240 describes and illustrates the company's types of portable loaders for piling concentrates and other bulk materials into box cars. Pp. 4.

Heavy Duty Diesels. Chicago Pneumatic Tool Co., 6 East 44 St., New York, N. Y. Bulletin 768, second edition, describes and illustrates features of the company's type 8 and 9 heavy-duty diesels for continuous service. Pp. 15.

Dragline. Lima Locomotive Works, Inc., Lima, Ohio. Bulletin 121-A illustrates and describes the manufacturer's Type 1201 shovel and dragline. Pp. 15.

Electrical Connector Guide. Burndy Engineering Co., 459 East 133 St., New York, N. Y. The manufacturer offers a method for making a survey of existing conditions of the operators electrical connections and data for selection of electrical connectors. Pp. 15.

Refractory Concrete. Atlas Lumnite Cement Co., 135 East 42 St., New York, N. Y. Booklet describes features and illustrates uses of a concrete having refractory properties suitable for service at high temperatures in furnaces and other industrial heating units. Pp. 24.

Safety Clothing. Industrial Gloves Co., 700 Garfield Blvd., Danville, Ill. 1940 Catalog describes and illustrates safety clothing and steel reinforced gloves, mitts, finger guards, arm protectors, and leggings. Pp. 18.

Gasket Marker. Crane Packing Co., 1800 Cuyler Ave., Chicago, Ill. Small folder describes a device for quickly outlining gasket sizes. Pp. 4.